Chapter 34

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WHY DIVERS DIE

INTRODUCTION

Experience of life suggests that anything which is fun tends to be either illegal, immoral, fattening, or dangerous. Recreational diving partly conforms to this universal law, ranking below hang gliding and parachuting but above most sports as regards the risk of a fatal accident.

Diving statistics from the USA, UK, Canada and Japans all show diving death rates of 15–30 per 100,000 divers per year, with the statistical chance of a fatality being about 2-3 per 100,000 dives.

These figures tend to contradict the misinformation issuing from some sections of the diving industry (fatalities of < 4 per 100,000 divers) which would have us believe that diving is a very safe recreation. It is not, but then we accept risks every day. Even driving an automobile to a dive site carries an appreciable (but much less) risk of death - a possibility which we generally regard with equanimity.

This chapter will show that many diving deaths should be preventable and that a diver ought to be able to minimise his chances of becoming a statistic by understanding and influencing the factors which are now known to be associated with diving deaths.

STATISTICAL EVIDENCE

The information presented here is mainly based on data gathered by valuable studies involving recreational diving fatalities. They have been conducted in different countries, but show strikingly similar results. The USA recreational diving deaths, originally compiled by John McAniff of the University of Rhode Island and then NUADC, are now collected and reported on by DAN, which recently analysed 947 open circuit scuba divers. The DAN survey also included technical divers, who dive deeper, longer and with gases other than compressed air. The BSAC do a similar job in the UK and DAN-AP Diver Fatality Project is the Australian compiler. Unfortunately significant data is frequently not available and so relevant causal factors are often underestimated. Another Australian approach (the ANZ series of diving fatalities) was to select and analyse only the accidents in which sufficient data was available to make the analysis credible, and to determine what factors materially contributed to the fatality. Most of our statistics come from this source and are rounded up, for simplicity.

OVERVIEW

❑ Diving Fatality Data

- 90% died with their **weight belt on**.
- 86% were **alone** when they died.
- 50% did **not inflate their buoyancy** vest.
- 25% encountered their difficulty first on the **surface**,
  50% actually died on the surface.
- 10% were **under training** when they died.
- 10% were advised that they were **medically unfit** to dive.
- 5% were cave diving.
- 1% of "rescuers" became a victim.

❑ Age.

The recorded deaths range from children (pre-teens) to septuagenarians. Some decades ago the average age of the deceased was in the early 20s. Then there developed a small increase in the middle ages (45-60 years). This bimodal curve has now become distorted on the other side, and the average scuba death age is now 43 years. The reasons for this increasing age of death are:

- The "youngsters" from the 1970-80 scuba diving boom are now older
- Cardiac disease, the sudden death syndrome, affects the elderly and diving introduces more cardiac hazards than many other sporting activities
- Diving is becoming a life-style option for the increasingly active and affluent elderly, with more older people taking up this sport

❑ Gender.

In the 1990s 1 in 10 of the fatalities were women. The actual percentage of women in the overall diving population was about 1 in 3, suggesting that women are safer divers than men. Even now females account for only 20% of the deaths.

❑ Diving Experience.

In most series, 1/3 were inexperienced, 1/3 had moderate experience and 1/3 had considerable experience. The most dangerous dives were the first dive and the first open water dive. In half the cases the victim, based on witness statements and previously logged dives, was extending his diving experience (depth, duration, environment, equipment etc.) and thus did not have the experience to undertake the final dive. For this reason, any diver extending any of his dive parameters (depths, durations, environments, equipment) is advised to do this only with more experienced supervisors.

❑ Major Causes of Death identified at Autopsy.

According to death certificates, most divers ultimately drowned (over 80%), but a number of factors usually combined to incapacitate the diver before this terminal event. Drowning is really only the final act in a sequence of events that lead up to this. It is a reflection of the medium in which the accident happens, more than the accident itself. Often it obscures the real cause of death. Unless there are other factors, drowning should never happen to a scuba diver, as he carries his own personal air supply with him! Drowning develops because of preceding problems, such as cardiac disease, pulmonary barotrauma, the stress disorders, unconsciousness from any cause, salt water aspiration, trauma, equipment difficulties or environmental hazards, etc. These are referred to in the following sections and in other chapters.

CONTRIBUTING FACTORS

Deaths usually followed a combination of difficulties, which alone may have been survivable. The factors contributing to deaths are easier to understand when classified, and we have categorised them into the following groups:

- **Diving Techniques** (Inadequate air supply, buoyancy, buddy system)
- **Human Factors** (medical, physiological, psychological)
- **Equipment Factors** (misuse, faults)
- **Environmental Factors.**

DIVING TECHNIQUES

Inadequate Air Supply

In the ANZ survey in **half the deaths (56%), critical events developed when the diver was either running low or was out-of-air (LOA, OOA).** When equipment was tested following death, few victims had an ample air supply remaining. The DAN survey found 41% in this situation.

Most problems arose when the diver became aware of a low-on-air (LOA) situation. Some divers then died while trying to snorkel on the surface, attempting to conserve air (8%).

Concern about a shortage of air presumably impairs the diver's ability to cope with a second problem developing during the dive, or causes the diver to surface prematurely and in a stressed state of mind, where he is then unable to cope with surface conditions. In many cases the LOA diver faced these difficulties alone, as his buddy who had more air, continued the dive oblivious to the deteriorating situation (see later). LOA situations should be avoidable by adequate dive planning, using a cylinder with ample capacity for the planned dive, and frequent observation of the contents gauge.

A particularly dangerous technique was to intentionally use all the available air (breathing the tank dry). Then there is much less opportunity to cope with unexpected eventualities and greater likelihood of emergency ascent and salt water aspiration. The dive should always be completed with at least 50 ATA remaining.

A description of the methods of preventing and coping with an OOA and LOA situation is in Chapter 11.

Fig. 34.1

In some cases the diver was using a smaller cylinder than a 2000 litre (72 cu.ft) tank. A 1400 litre (50 cu.ft) cylinder has much less endurance than a conventional cylinder, and allows fewer breaths once a LOA situation develops at a significant depth. Also, a diver using a smaller cylinder will usually run out of air sooner, encouraging separation from his group.

Buoyancy

In the ANZ survey, half **the diving victims (52%) encountered buoyancy problems.** Most of these were due to inadequate buoyancy, but some (8%) had excessive buoyancy. The DAN survey buoyancy problems were the commonest adverse event leading to death.

The **buoyancy changes peculiar to wet suits** were a significant factor. The considerable buoyancy offered by a wet suit at the surface needs to be compensated by weights. An approximate formula for this is:

- 1 kg for each 1 mm thickness,
- 1 kg for "long john" extensions and a hood,
- 1 kg for an aluminium tank,
- ± 1–2 kg for individual body variations in buoyancy.

Based on the above formula, **40% of divers who perished were found to be grossly overweighted** at the surface. This factor would have been greater at depth. When weighted according to this formula, a diver should be neutrally buoyant at or near the surface. In this state, descent or ascent are equally easy.

During descent, the wet suit becomes compressed, making the diver negatively buoyant. This is where the **buoyancy compensator (B.C.)** comes in. It is inflated just sufficiently to restore neutral buoyancy. This is why it is called a buoyancy compensator.

Evidently, **some divers deliberately overweighted on the surface**, using this excess weight to descend more easily and were then using the B.C. to maintain depth and then later to return to the surface. This places excessive reliance on the B.C.. This dangerous practice is unfortunately promoted by some instructors. It has advantages from a commercial point of view, as it expedites training. Groups of divers can be quickly taught to descend with minimum skill. The technique is less advantageous in terms of longevity of the diver.

In another fatality survey on buddied divers who ran into LOA/OOA situations, it was of interest that irrespective of who became OOA first, the overweighted diver was the one who died – at a 6:1 ratio. See Chapter 5, dealing with weights, buoyancy compensators, etc.

In spite of being heavily reliant on their B.C., many divers then misused them**.** Examples of this include accidental inflation or over-inflation causing rocket like ascents ("Polaris missile effect"), confusion between the inflation and dump valves, and inadequate or slow inflation due to being deep or LOA. The drag induced by the inflated B.C. (needed in many cases to offset the non-discarded weight belt) was a factor contributing to exhaustion in divers attempting to swim to safety on the surface.

There are other unpleasant consequences of buoyancy problems. The American Academy of Underwater Sciences, in a symposium in 1989, reported that **half the cases of decompression sickness** were **related to loss of buoyancy control.** After acquiring the initial open-water certificate, possibly the best course to undertake would be on buoyancy control.

Ditching of Weights

This was omitted by most victims (90%). This compelled them to swim towards safety carrying many kilos of unnecessary weight, and made staying on the surface very difficult in these cases. This critical and avoidable factor should be easily remedied by restoring the traditional weight belt ditching drills.

Earlier diving instructors taught that the weight belt was the last item put on, the first taken off. It was to be removed and held at arm's length in the event of a potential problem. The diver then had the option of voluntarily dropping the belt if the situation deteriorated, or replacing it if the problem resolved. When problems did develop, the belt was dropped automatically! Some current diving students now question the validity of dropping these lead (? dead) belts – perhaps the high cost of replacement is worth more than their lives. "Lead poisoning" is a frequent contribution to fatalities.

When ditched, the belt is held at arms length to avoid falling and fouling on other equipment. This entanglement occurred in some of the reported fatalities. In other cases, the belt could not be released because it was worn under other equipment (e.g. B.C., backpack harness, scuba cylinder etc.), or the release buckle was inaccessible because a weight had slid over it, or it had rotated to the back of the body. In some cases the belt strap was too long to slide through the release buckle. Other fatalities have occurred where release mechanisms have failed, due to the use of knotted belts (which could not be untied), or lead balls contained within a backpack.

In an emergency requiring either ascent or buoyancy, to keep the diver afloat on the surface, several kilograms of flotation are immediately available by simply discarding the weight belt. This action also results in a more consistent, controlled ascent than with an inflated B.C..

Buddy Diving System

The value and desirability of the buddy system is universally accepted in the recreational diving community. Two maxims have arisen in diving folklore from this concept:

- "Dive alone – die alone"

• "Buddies who are not in constant and direct communication are not buddies,
— merely diving in the same ocean".

In spite of this, **only 14% of divers who perished still had their buddy with them,** and in the Hawaiian series it was 19%. In 33% of the ANZ cases, the deceased diver either dived alone or voluntarily separated from his buddy beforehand, 25% left their buddy after a problem developed, and 20% became separated by the problem. Of those who started diving with a buddy in the DAN series, 57% were separated at the time of death.

A common cause of separation was one diver (the subsequent casualty) having inadequate air, OOA or LOA. In this case, the buddy often continued the dive alone, or accompanied the victim to the surface, before abandoning him and continuing the dive.

There were many misapplications of the buddy system. In some cases more than two divers 'buddied' together, leading to confusion as to who was responsible for whom. A particular variant of this is a training technique in which a group of inexperienced divers follows a dive leader. When one becomes LOA, he is paired with another (usually another inexperienced diver) in the same situation, and the two instructed to return to the surface together. Often the heaviest air consumers are the least experienced and are over-breathing through anxiety. Two such inexperienced, anxious divers, both critically low on air, are then abandoned underwater by the dive leader and left to fend for themselves!

In others, the buddy was leading the victim and therefore not immediately aware of the problem. Generally, the more experienced diver took the lead, affording him the luxury of constant observation by his buddy, while he gave intermittent attention in return. In this situation, unless a **"buddy line"** is used, the following diver (upon developing a problem such as LOA or OOA) has to expend precious time and energy and air, catching his buddy to inform him of the difficulty. Often this was impossible, and the first indication the leading diver had of the problem was the absence of his buddy, who by this time was unconscious on the sea bed or well on the way to the surface.

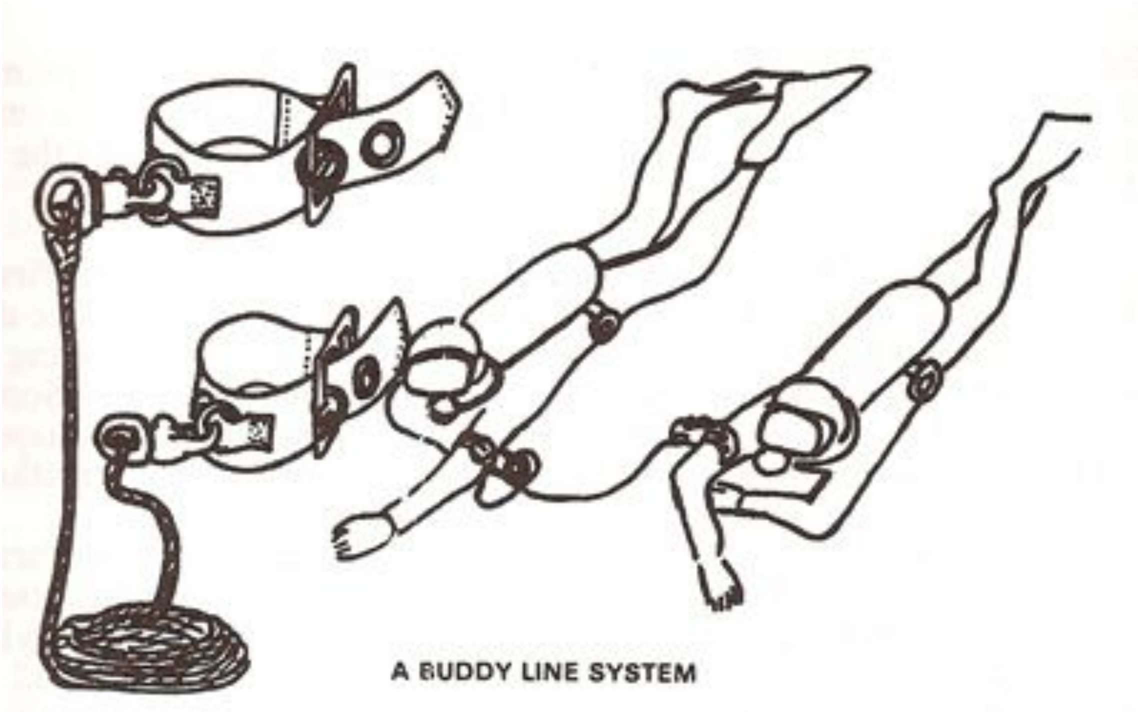

Fig. 34.2
A buddy line may be life saving

Fig 34.3
But not always

❑ Buddy rescue.

In only a minority of cases was the buddy present at the time of death. Most divers ultimately died alone, usually because of poor compliance with the principles of buddy diving. In only 1% of cases did the buddy die attempting rescue, indicating that adherence to the buddy principle is reasonably safe for the would-be rescuer.

❑ Buddy breathing.

4% of fatalities were associated with failed buddy breathing. In a study of failed buddy breathing conducted by NUADC, more than half were attempted at depths greater than 20 metres. In 29% the victim's mask was displaced and the catastrophe of air embolism occurred in 12.5% of cases.

One in 8 victims refused to return the demand valve, presumably to the righteous indignation of the donor. In one reported instance, knives were drawn to settle the dispute! Nevertheless, donating a regulator rarely results in the donor becoming the victim.

The use of an **octopus rig** or (more sensibly) a complete **separate emergency air supply** (e.g. "Spare Air") would appear to be a more satisfactory alternative, having the added advantage of providing a spare regulator for the owner in the (not so rare) event of a failure of the primary air supply.

HUMAN FACTORS MEDICAL, PSYCHOLOGICAL AND PHYSIOLOGICAL

In at least **25% of cases, the diver had a pre-existing disease which should have excluded him from diving** (compared to 8-10% in the potential diver trainee population). The diseases either killed the diver or predisposed him to the diving accident.

In assessing the cause of scuba fatalities, it is too easy to ignore the disorders which have no demonstrable pathology, such as panic and fatigue, but to do so results in less understanding of the incident. Drowning obscures many other pathologies and some, such as asthma or the sudden death syndrome, may not show up at autopsy.

Panic

39% of deaths were associated with panic. Panic is a psychological stress reaction of extreme anxiety, characterised by frenzied and irrational behaviour. It is an unhelpful response which reduces the chance of survival. This topic is covered in detail in Chapter 7.

Evidence of panic was derived from witness accounts of the diver's behaviour, in the Australasian series. Other studies suggest a 40–60% incidence of panic.

Panic was usually precipitated when the diver was confronted by unfamiliar or threatening circumstances such as LOA, OOA, poor visibility, turbulent water, unaccustomed depth, buoyancy problems (usually insufficient buoyancy), or separation from diving companions.

After panicking, the diver frequently behaved inappropriately by actions such as failure to ditch weights or inflate the B.C., rapid ascent, or abandoning essential equipment such as the mask, snorkel and regulator.

Fatigue

In 28% of cases fatigue was a factor. Fatigue is a consequence of excessive exertion, and limits the diver's capacity for survival. Physical unfitness aggravates it.

It commonly arose from a variety of circumstances including attempting to remain on the surface while overweighted, long swims in adverse sea conditions or swimming with excessive drag from an inflated B.C..

The fatigue factor was not restricted to unfit divers — under special circumstances any diver will become fatigued. In some cases the fatigue was associated with salt water aspiration syndrome, cardiac complications or asthma.

Salt Water Aspiration

This factor was present in 37% of cases. It refers to inhalation of small amounts of sea water by the conscious diver.

In many cases this was the result of; a leaking regulator, aspiration on the surface after removing the regulator, and buddy breathing. In most cases salt water aspiration was a pre-terminal event as the situation became critical. It frequently predisposed to the development of panic, fatigue, respiratory and other complications.

Pulmonary Barotrauma

13% of deaths had autopsy evidence of pulmonary barotrauma (burst lung)**.** In some cases it was a complicating factor rather than the initial cause. Factors promoting the barotrauma were diverse, including panic, rapid buoyant ascents, asthma and regulator failure. Half the cases had an identified cause for the illness. The other half were unexplained.

Cardiac (Sudden Death Syndrome)

In these cases there was either gross cardiac pathology or a clinical indication of cardiac disease (See Chapter 35). In the DAN series, 26% of deaths were due to this. Of the cardiac deaths, 60% complained of chest pain, dyspnoea or feeling unwell before or during the dive.

Victims tend to be older – cardiac causes explain 45% of the scuba deaths in those over 40 years. They tend to be more experienced divers, often with a history of known cardiac disease (arrhythmias or ischaemia) or high blood pressure - often under control with medication (especially beta blockers).

They usually die quietly and the pathophysiology is probably a cardiac arrhythmia (ventricular fibrillation). Resuscitation is difficult or impossible under these environmental conditions. The trigger factors producing this very rapid ineffective heart beat include the following; exercise, drugs, hypoxia from salt water aspiration, respiratory abnormalities from breathing under dysbaric conditions through a regulator and with restrictive clothing and harness, cardio-pulmonary reflexes and cold exposure.

Asthma

In at least 9% of deaths the diver was asthmatic in the ANZ survey, and in at least 8% of cases asthma contributed to the death. In some other surveys (especially those with less data on each fatality, or those that do not specifically check the previous medical history), this data is not so obvious.

Asthmatics should normally be excluded by a competent medical examination. Even so, surveys have shown that between 0.5 and 1% of divers are current asthmatics. When this figure is contrasted with the 9% of fatalities who have the condition, it implies that **asthma is a significant risk factor.**

There was often a series of adverse contributors to death in this group, including panic, fatigue and salt water aspiration. The ultimate pathology was usually drowning or pulmonary barotrauma.

The risk of pulmonary barotrauma is predictable, considering that asthma narrows and obstructs airways. Added to this is the possibility of an incapacitating asthmatic attack during the dive. A considerable number of divers in the survey died this way, some as they were returning to get their medication (aerosol inhalers). Others took it before the dive!

The diving environment can aggravate asthma in several ways:

❑ Salt water aspiration.

Respiratory physicians use nebulised salt water to provoke an asthmatic attack in cases of questionable asthma. Divers immerse themselves in such a solution and often breathe a fine mist of seawater through regulators.

❑ Cold dry air.

Breathing this air precipitates attacks in some asthmatics. Divers breathe this type of air continuously. It is carefully dried by the filling station before being used to fill scuba tanks, and cools as it expands in the regulator.

❑ Exertion.

This aggravates many attacks. Even the most routine dive can require unexpected and extreme exertion, due to adverse environmental factors such as rough water or currents.

❑ Hyperventilation.

The effects of anxiety cause hyperventilation and changes in respiratory gases. This will have little effect on normal lungs. It provokes asthma in those susceptible.

❑ Breathing against a resistance.

Many of the cases first notice problems at depth, where the air is more dense, or if there is increased resistance in the regulator – such as with a LOA or OOA situation.

A study from Denver showed that although normal divers did not show any change in respiratory function with exercise or breathing through scuba regulators, asthmatics had decreases of 15% and 27% respectively.

Vomiting

Apart from the cases that vomited during resuscitation – and there were many – in 10% vomiting initiated or contributed to the accident. It was often produced by sea sickness or salt water aspiration, but ear problems and alcohol over-ingestion also contributed.

Nitrogen Narcosis

This was an effect of depth, and contributed in 9%, but was never the sole cause of death in the ANZ series.

Respiratory Disease

A further 7% of casualties had chronic bronchitis, pleural adhesions, chest injury or other respiratory conditions. Because divers with these conditions are in a minority, they appear to be over represented in the deaths.

Drugs

Alcohol and cannabis (marijuana) are well known contributors to drowning. Cocaine is an established cause of sudden death in athletes. What surprised us was the apparent association between drugs taken for hypertension and the deaths from the sudden death syndrome. Anti-asthma drugs seemed to have the same association.

Decompression Sickness

The dread of DCS is prominent in the minds of most divers. Perhaps this is why there are no deaths due to this condition in the ANZ studies, and less than 1% in the NUADC. Hawaiians reached 4%, due to deep diving for black coral. The DAN survey has 2.5%, probably because of the inclusion of technical divers, who often dive deeper – the mean depth being 68 metres (226 ft) in that study.

While DCS is an important cause of serious disability (such as paraplegia) in all divers, it is not a frequent cause of mortality in recreational divers. This is not, however, true for professionals.

EQUIPMENT PROBLEMS

A significant proportion of deaths were associated with equipment malfunction (35%) or misuse (35%). There was some overlap in the equipment faults and the equipment misuse categories. In spite of the advanced technology available, modern equipment still frequently fails and divers need to be prepared for this possibility (see Chapter 5).

Regulator

In 14% of deaths there was a regulator fault, and in 1% it was misused. Subsequent testing of the regulators showed the majority of problems were due to leakage allowing inhalation of salt water, but in some cases there was excessive breathing resistance following a mechanical dysfunction. In a few cases, the regulator failed catastrophically, or the hose 'blew out'.

The difficulty of obtaining useable air from the regulator was often complicated by other factors such as panic or exhaustion.

Fins

13% of cases lost one or both fins. In some cases this was due to defective or ill fitting fins, but in the majority of instances the cause was not obvious.

A likely explanation is that the fin(s) was lost because of vigorous swimming efforts during attempts to stay afloat with inadequate buoyancy, or during an attempt to swim to safety. Once a fin is lost swimming efficiency is drastically impaired. Panic and fatigue probably had a significant role in these situations.

Buoyancy Compensator

In 8% of cases the B.C. malfunctioned. Usually this was due to failure of the inflation system, but some B.C.s did not remain inflated.

In 6% of deaths, the B.C. was misused. Some divers confused the inflation and dump valves, usually causing over-inflation of the B.C. and precipitating an uncontrolled ascent. Others pressed the wrong button and sank when they wanted to float.

Scuba Cylinder

12% of deaths had problems with the cylinder, usually from misuse. These included under-filling, using a cylinder too small for the dive, the cylinder being dislodged from its harness, and failure to turn on the cylinder valve.

Other Equipment Problems

In 5% or less of deaths, problems were experienced due to failure or misuse of:

- **weight belt** – usually inability to discard it (see Chapter 5)
- **harness** – design faults or covering the weight belt
- **mask** – loss, flooding, and broken straps
- **protective suit** – ill fitting, usually too tight
- **lines** – entanglement
- **gauges** – faulty readings, blow off.

ENVIRONMENTAL PROBLEMS

Environmental factors contributed to 62% of deaths (see Chapter 6).

Deaths near the Surface

25% of the accidents commenced on the surface, and 50% of the divers died at the surface. This may seem surprising as most divers would regard the surface as a safety zone. In many cases they were compelled to surface because of exhaustion of the air supply.

Turbulent (White) Water

Difficult water conditions caused problems in 36%. These included excessive **current, rough** water, **surf** and **surge** around rocks, **underwater surge** from wave movement, and impaired **visibility** caused by these conditions.

These unfavourable conditions often assailed the diver who was forced prematurely to the surface, OOA or LOA, and who was also frequently overweighted and hampered by the drag of his inflated B.C.. Exhaustion or panic then resulted in drowning.

Depth

Excessive depth was a factor in 12%. Often the fatal dive was the deepest ever for the victim. Deep water is a more gloomy and dangerous environment.

The dangers of excessive depth are predictable. They include; increased air consumption, impaired judgment from nitrogen narcosis, colder water, reduced visibility, slow or failed response to B.C. inflation, excessive air consumption, resistance to breathing, and a prolonged ascent in the event of problems.

Other Environmental Problems

Factors which contributed to less than 10% of fatalities included:

- **cave** dives – sometimes causing multiple deaths
- **marine animal injury** – including shark and other animal bites, marine stings (3–6%)
- **difficulties entering** and **exiting** the water
- **cold**
- **entanglements** with ropes, lines and kelp
- **entrapment** – under caves, ledges, or boats
- **night** diving.

DEATHS IN PROFESSIONAL DIVERS

Professional divers have a much higher death rate than recreational divers, especially when operating from deep sea oil rigs. Death rates up to 4.8 per thousand divers per year have been reported, however recent figures from the U.K. indicate that the current deaths in professional divers is now approaching that of recreational divers (30/100,000 per year). Unfortunately, technical divers, have taken over the higher fatality rates previously claimed by professionals, with an incidence of 3.5 times the open circuit recreational scuba fatalities (based on our current inadequate statistics in 2010).

The causes of death differ from recreational divers. DCS and CAGE accounted for up to 28% of deaths. These divers not only frequently develop DCS, but sometimes die from the disease.

Because of the inhospitable environment in areas like the North Sea, cold and heavy seas were a significant factor in deaths, as was increased depth and duration in technical diving. Enclosed diving, such as in caves, salvage, wrecks, and under ice, were also hazards to which the recreational diver is not usually exposed.

Other important factors were equipment failure (saturation divers are highly dependent on equipment integrity for their survival), and the use of more complex gas mixtures and equipment.

Surprisingly, in spite of legislation requiring careful medical supervision, 6% of deaths had a contributing medical factor.

SUMMARY

Diving fatalities generally arise from a combination of factors, none of which alone would have caused disaster.

The contributing factors show an emerging pattern which needs to be addressed by diver education and training. For example, the majority of deaths were in divers who were medically unfit to dive or had a **LOA or OOA element.**

Competent and repeated **dive medical examinations** are essential. **Diver training** and re-training should result in proper planning, buoyancy control and air supply monitoring. Most of the deaths in recreational divers were preventable.

Case Report 34.1 A composite diving fatality might unfold as follows:

A young, inexperienced, slightly overconfident, indifferently trained, male diver undertakes a dive in open water under conditions with which he is relatively unfamiliar. He is healthy but does no regular exercise apart from occasional diving. He has a vague dive plan which he does not discuss with his equally casual buddy. He is mildly anxious because of the unfamiliar conditions. He follows his usual practice of using a generous number of weights, initially inflating and then deflating his B.C. on the surface, to allow his weights to help him descend. Fascination with the environment leads him and his buddy to descend to 40 metres, deeper than they originally intended. He checks his contents gauge and is alarmed to find he is close to his reserve. His anxiety is increased by the realisation that there may be a decompression requirement for this dive, but he may have insufficient air to complete even a safety stop. He is unsure of the decompression requirement, if any, and he did not bring any tables with him. He had not chosen any of the more conservative options on his decompression meter.

He activates the inflation valve on his B.C. but gets so little response that he swims for the surface. He heads for the surface alone with some urgency, unable to communicate with his buddy who is some distance away and preoccupied with other marine life. His air supply runs out during the ascent and he arrives at the surface in a state of panic.

He has extreme difficulty staying afloat but in his frenzied state, neglects to ditch his weight belt or orally inflate his B.C.. His predicament is aggravated by inhalation of sea water and the loss of one of his fins. He becomes exhausted trying to remain on the surface, because of his negative buoyancy and reduced propulsion.

A search team later found his body on the bottom – directly below where he surfaced. They have difficulty in surfacing the body, until they release the weight belt.

The most significant factors in recreational diving fatalities are:

- **diving with disqualifying medical conditions**
- **stress responses -panic and fatigue**
- **salt water aspiration**
- **environmental water movement**
- **buoyancy problems**

- **inadequate air supply - LOA or OOA**
- **adverse sea conditions**
- **failure to ditch the weight belt when in difficulty**
- **ignoring or misapplying the buddy system**
- **improper use of equipment**
- **failure of equipment.**

PREVENTION

Many of the factors associated with diving deaths are avoidable.

Contributing **medical** factors should be largely preventable by **adequate dive medical examinations** prior to commencing diving and periodically after that, especially after diving and non-diving illnesses. With increasing age, the examinations should be more frequent.
As a rule of thumb, routine medical examinations should be at least every 5 years when young, reducing to annual with old divers.

Some changes in the emphasis of diver instruction, aimed at better education concerning the high risk areas of diving, would be helpful. Divers who may be knowledgeable of decompression theory and practice, are running out of air and drowning in solitude, with their excessively laden weight belts still firmly attached.

Before diving is attempted, aquatic skills including unassisted swimming and snorkeling should be acquired. Scuba training should be from professional diving instructors, both for the initial open water training and subsequent courses on buoyancy control, rescue and advanced diving. Supervision is needed while extending diving activities involving different environments, equipment or dive parameters.

Fig 34.4