

Provisional Report on the 1976 Australian Diving Deaths

Overview

There were twelve identified diving related fatalities in 1976. Of these two were in swimmers using fins, mask and snorkel, eight were scuba divers and one was using surface air supply (hookah) and there are insufficient details at present available to assign one case. Both the snorkel users were unused to its use and one of them was a poor swimmer, though he dissembled on this matter to others. One professional diver, using scuba, ordered his boat to keep one propellor turning in order to maintain position against an ebb tide while he investigated an underwater object. As soon as he entered the water he was drawn into the propellor tunnel and killed. The other scuba deaths occurred at the surface, often related to low air/deteriorating water conditions/cold. While ignorance was gross in two cases, in the remainder this was not the cause as 4 had C-cards and one other had 30 years of diving experience. One victim suffered a fatal "heart attack" and another was said to be obese: the remainder were in good health. Buddies, where present, behaved creditably. The rapidity of the change through unconsciousness to death is worthy of comment. Once more the wearing of a functioning buoyancy vest can be seen to be a critical factor: two CO₂ type vests failed their wearers at the critical time. The hookah diver died through the cumulative errors of others and unsafe practices that were certain to produce a death at some stage. He was supplied with oxygen while working at 70 ft. This was possible because the gas supplier had the same thread on cylinders used for both gases and the colour-code was hidden by the method of storage. Naturally this user has corrected the faulty procedure but recurrence will remain a possibility until a different connection is required for different gases. This problem has been found in hospitals; faced with similar dangers, gas cylinder fittings were altered. In constructing the report the superiority of the information in cases where the Coroner spoke to the witnesses as well as viewed their depositions was evident, fewer points of interest remaining undocumented. The basic findings are given in Table 1.

Method

In most cases the details are from statements taken soon after the incident by Police Officers skilled in guiding witnesses to make clear what has just occurred. They are concerned with excluding, as is the Coroner himself, any possibility of illegal or criminal aspects. It is no part of the task of those concerned to consider deeply why that person died while another would have survived. Luckily in most cases background detail is included. In a few instances reports from those with knowledge of the events are received and these gain from the less formal setting out of the events. News cuttings are a vital part of the discovery of cases though they may not be entirely correct with all details on occasion. Additional cases may remain still undiscovered and readers are invited to send information they may possess concerning all types of diving incidents, not only concerning fatalities.

Case Notes

1. Snorkel (breath-hold) divers are represented by two fatalities, both overseas visitors to the Barrier Reef. Both were inexperienced in the use of fins, mask and snorkel. While one was said to be an adequate swimmer, the other was apparently not only a very poor one but had previously only use a snorkel while in shallow water. the warm, still, clear waters of the Reef can drown the unwary as easily as the colder, rougher waters of other areas. In neither case was help sufficiently near at the critical time.

Case BH 76/1

This unfortunate visitor, aged 28, was travelling on holiday with relatives on a yacht. The party decided to view the coral off one of the islands on which they had landed. The victim, described as an average swimmer, had previously only used a snorkel once. Early in this outing he was seen to be having some difficulty in co-ordinating breathing when underwater (through water entering the snorkel). This difficulty appeared to have been resolved before the party separated, the victim remaining in the shallow (3 ft) water 60 ft from the beach when the others entered deeper water. One member of the group became cold and returned to shore with the expectation that the victim was following him. However a headcount of the remaining swimmers disclosed the victim's absence and the alarm was raised. About 10 minutes later a body was seen floating on the surface, minus mask and snorkel. Resuscitation attempts were unavailing.

Case BH 76/2

This death occurred during a normal commercial boat trip to an offshore reef. There was seemingly an assumption that all swimmers were fully competent to manage their own safety in the water, no actual proof of any experience being requested. There was not a small dinghy available to recover anyone getting into difficulties. Some remained aboard after the spearfishermen and the snorkelers had left. They happened to see the victim, aged 24, surface and wave his arm and shout for help. He was estimated to be about 150 m distant. Two scuba divers jumped into the water from the boat and swam to the spot but were initially unable to locate him. It was at least 6 minutes before he was found, minus mask and snorkel but still wearing his weight belt, in 10-12 m of water. The body could only be raised with difficulty because the weight belt had been put on in such a manner that it was difficult to release, though the victim had shown another person that the quick-release worked easily a few days previously. His claim that he had 4 months of experience with a snorkel was misleading, he having only used it when floating in shallow water as he was actually only able to swim a few strokes. The sea was calm and not an adverse factor. Resuscitation attempts were unsuccessful.

2. Scuba divers suffered eight identified fatalities, equally divided between the ignorant and certificated. All appear to have experienced the critical events when at the surface if one includes the unfortunate commercial diver who was destroyed by a propellor a few feet beneath the actual surface. It is not possible to state with certainty every event and factor surrounding fatal incidents but there is obviously a highly critical period in every dive when the diver is at the surface and death, whether following inhalation or from some other cause, can occur with extreme rapidity/ Reliable surface buoyancy is an obvious safety factor and the two instances of failure with CO₂ inflatable vests in this small series seem significant. As the buoyancy is most urgently required by a diver already in trouble it would be inappropriate to rely on any aid requiring oral inflation. The added security that buoyancy gives would allow time for the victim to think rationally and perhaps even drop his weight belt. The organised diving club outing's fatality was not the fault of either the buddy or the club and in other cases also the buddies did all possible to offer aid once it seemed to be necessary.

Case SC 76/1

Being an excellent athlete and swimmer, and having tried the use of snorkel and scuba (for 20 minutes) some 6 weeks previously, this healthy 18 year old accepted the opportunity offered by two others to again scuba dive. Their experience is unknown, as is also the source of the equipment used. The dive was to be off a rocky shelf that continued out to sea as a reef. It was a wave swept entry point such as experienced swimmers of all types would have totally avoided. One of the scuba divers and the victim entered the water but both were soon hit by a succession of unexpectedly large waves and tumbled about in the wash. The buddy felt the victim grab at him

and observed on looking round that he looked dazed and no longer had the mouthpiece in his mouth. They were now being pounded on the rocks and only reached the shore again through the assistance of the third diver and the luck that one wave washed them sufficiently high on the rocks to make escape possible. It was stated that onlookers offered no help either at this desperate time or later with resuscitation attempts. There was possibly a little delay before effective resuscitation was initiated but it was continued efficiently when lifesavers and a rescue helicopter arrived, and continued in transit to a nearby hospital. Consciousness was never regained and death occurred three days later from the effects of cerebral anoxia and aspiration of water.

Case SC 76/2

About a year before this incident the victim had successfully completed a diving course and had been adjudged a good student. Since then he was thought to have made 8 dives. On this occasion he was with a friend. They proposed to swim to a nearby reef and then to scuba dive, but as he had a recently healed perforated eardrum he warned his companion that he might have to return to shore if he experienced any ear trouble. The other diver led the way as they started their surface swim out to the reef, and when half way there he looked back and saw his friend wave once, an action he took to indicate that he was aborting the dive. This was the last time the victim was seen alive, for when the leading diver reached the reef and stood up to check there was no sign of the victim. This made him a little alarmed so he returned to the beach. A short time later, while undecided as to what to do, he observed activity by the lifesavers who were attempting to resuscitate a person a snorkel diver had found lying on the seabed in 4 m (13 ft) of water about 70 m off the beach. Weight belt and tank were still on the body. Neither diver wore a buoyancy aid and the scuba air was turned off, it being their intention only to start using scuba when the dive commenced at the reef. The sea was calm. Autopsy revealed drowning changes and no disease changes in this 36 year old man. It is easy to suppose that survival would have been assured if a buoyancy vest had been worn and the air had been turned on.

Case SC 76/3

This experienced part-time professional diver forgot the powerful suction effect of a revolving propellor, with fatal results 15 seconds after entering the water. He was aged 40, had a basic C-card qualification and was respected as being conscientious in his work. This day's task was the finding, and later recovery, of a large and very valuable anchor that had been lost in a harbour tideway, a type of search and recovery task with which he had previous experience. The method he chose was to drag a large metal bar between two steel hawsers which led over the sides of a powerful tug. They were steaming into an ebb tide when an underwater obstruction was encountered that required checking. The diver ordered the tug captain to maintain position against the water flow by use of one propellor at low speed. The propellers were in short tunnels a few feet beneath the surface.

His plan was to follow one of the hawsers till reaching the object that he been fouled. He was warned about the propeller's turning and apparently said that if this caused problems he would try a different method the next time. This was the first time he had been known to enter the water in such circumstances. He jumped overboard and swam back to the wire hawser before submerging. A few seconds later a thump was heard and blood stains appeared in the water. He had apparently been irresistibly sucked into the propellor tunnel and killed.

Case SC 76/4

The victim was a 20 year old diver with two years experience, his buddy one year. Both had taken courses and obtained C-card certification, in different States, about a year previous to this dive. As the buddy had only dived 4-5 times in total he accepted that his friend had more experience and would be likely to use less air on the dive.

For this reason the friend exchanged his hired tank for his buddy's equipment. There were no contents gauges on the tanks but both had been recently filled. The buddy diver alone had a buoyancy vest, this being purchased the day before the fatal outing. At the dive site, an off-shore reef connected to the beach by a jetty, they debated the suitability of the sea conditions but the victim thought that despite the cold windy conditions and a choppy sea it was possible to dive successfully. He was not experienced in the local conditions and obtained no local advice, and being motivated to some degree by the \$13 he had outlaid to hire the tank and regulator was unwilling to accept a no-dive decision.

They swam out underwater after a short delay to correct the buddy's weighting, keeping close together. After a period at the reef they decided to return to the jetty steps, again underwater. However the buddy soon became low on air, pulled his reserve, surfacing after signalling his intention. The two then decided to surface swim the remaining distance together, the victim to be the leader. The buddy inflated his vest and as a natural matter of convenience swam on his back as he followed, thus inevitably losing sight of the other. He became aware of shouts from people on the jetty but could not discern what was being said, being distracted in part by stomach and leg cramps, exhaustion and increasing waves. Witnesses on the jetty saw the victim wave as if for help and a diving instructor, who was just concluding a lesson with two pupils at the jetty steps, responded by dropping his tank (to increase his surface swimming speed) and going to offer assistance. However the victim was no longer visible on the surface when he reached the spot so he returned to don his scuba tank and then started an underwater search. The victim was found lying on the seabed in about 5 m (16 ft) of water. The weight belt and tank were easily released and the body recovered. The period of submergence was over 15 minutes so resuscitation attempts failed. The equipment was later recovered and tested. Apart from being empty of air, there was no adverse comment on the equipment.

Case SC 76/5

Aged 24 and armed with one year's diving experience and a C-card obtained after a course, this diver was on a boat dive with fellow club members. The sea and weather conditions were good, underwater visibility excellent. All the divers were certificated and were checked as to their equipment and buddy pairing before being allowed to enter the water. As the boat owner accurately summed it up, "I checked because I am the one who has to fish them out later". He remained in the boat and was a very efficient "surface cover" as events showed. The victim and buddy kept close together during descent down the sloping sea floor and eventually reached 30 m (100 ft), here meeting by chance a pair who had entered the water before them. One of this pair realised that he was low on air so they made an orderly ascent. Suddenly the buddy realised that she was alone, her companion no longer visible. She therefore returned to the anchor line, expecting to find the buddy there or already surfaced and waiting at the boat. She ascended alone to find that the line had been buoyed, the boat was gone and that the other pair of divers at the float had not seen the missing diver. The man left in the boat reported that he had seen a diver surface about 150 m away and call several times for help, so he had buoyed the anchor and proceeded immediately to the spot. Unfortunately no trace of any diver could be seen so he returned and collected all the dive party, checked that one was indeed missing, and returned to institute an underwater search in the area of sighting. Other divers joined in and ultimately the body was discovered in 12 m (40 ft) of water in the expected area. The weight belt was still in position and the CO₂ type vest was not inflated. As more than one hour had elapsed there was no point in resuscitation attempts. Subsequent investigation showed that the tank still contained 900 psi of air and that all the quick-releases functioned correctly. The victim had previously spoken about free-flow trouble with the regulator to a friend but had not mentioned this at the dive shop when obtaining air for this dive, so it was presumably an inconstant problem. Testing showed that there was a mild problem with water entering

the mouthpiece but this was not to a degree likely to trouble a trained diver. However the lifejacket's CO₂ cylinder spontaneously fired after the vest had been washed and put aside for later examination by the police. It was thought likely that the firing pin had dented but not fully pierced the seal during the incident and the perforation became completed as a result of later handling.

There was no known reason for the victim to make a sudden ascent without warning the buddy first, for visibility was good and his air supply was still adequate. Possibly a shark was seen or a malfunction of the demand valve occurred. As the victim shouted several times after reaching the surface and the autopsy showed no signs of pulmonary barotrauma, only drowning changes being described, air embolism cannot be readily suggested. It is possible that after a successful 30 m (100 ft) ascent there was some surface buoyancy inadequacy, the vest failed to inflate and water was inhaled before thought could be given to releasing the weight belt.

Case SC 76/6

The initiating factor in the sequence of events that led to this fatality was the loss of a facemask, followed shortly by a unplanned water entry. The diver, aged 55, had 30 years experience with scuba and was standing on a reef with his buddy after a dive. They both raised their masks while discussing whether to return to shore along a jetty or by swimming. The buddy was tired and getting low on air, underwater visibility was poor, but it was decided to swim. At this time a small wave broke over the reef and tumbled the victim off his feet. He surfaced a short distance away, minus his mask. After helping him back onto the reef the buddy attempted to recover the mask but the turbulent bubbling water off the reef made this impossible. He surfaced from his search to see the victim floundering on the reef so attempted to reach him again, and the next thing he remembers is seeing the victim 10 m away from him in the water. He inflated his own buoyancy vest and managed to rejoin his friend. He told him to drop his weight belt but this was not done and neither did the victim follow advice to inflate his vest, though he was seen to attempt to manipulate the vest's mouthpiece. He was still retaining the regulator in his mouth but seemed to be in some undefinable trouble. The buddy, despite trouble with cold hands, managed to drop the victim's weight belt but was unable to manipulate the release of his own with one hand. The victim was passive at this time and the buddy started to tow him to shore but had to let go for a short time to use both hands to drop his own weight belt. During this period the victim drifted 10 m away again and increasing waves prevented contact being re-established. A motor boat chanced by, saw the buddy's wave for help and picked him up. He was exhausted and completely out of air by this time. The boat was then directed to the victim, who was unconscious but retained the demand valve mouthpiece in his mouth. It is not certain whether he was still breathing. Resuscitation was started in the boat and continued on the beach but was unavailing.

Investigation later showed that the victim's tank still contained 1,100 psi air but that the inflatable vest had an "expired" CO₂ cartridge and the mouthpiece was not functioning. The vest was in poor condition and was described as being useless. The autopsy showed drowning as the cause of death. The victim showed no real signs of consciousness after being seen to attempt to use his vest. The buddy had two years (45 sea dives) experience but felt remorse that he had not been more physically fit so as to do more for his companion. The record shows that in fact his actions were highly commendable despite the unfortunate outcome.

Case SC 76/7

Three friends went scuba diving together off a wharf jetty. The water was clear but cold, with depth about 12-13.5 m (40-45 ft). They swam underwater in visual contact about 5 m (16 ft) apart and surfaced when one became low on air. They all surfaced normally and started to make their independent ways back to the jetty. There

was by now a 0.6 m (2 ft) "slop" to the water.

A witness on the wharf heard what he described as "a gurgling yell" and looked down to see a diver on the surface paddling feebly with his hands, his face held up out of the water. He was seen to let his head fall forward and his face submerge. Another witness saw the victim estimated as being 9 m (30 ft) from the jetty, on the surface attempting to release his tank: his mask was half full of water and water was going into his mouth. The alarm was raised immediately. The two other divers, who were approaching the steps on the other side of the jetty to that chosen by the victim, were told their friend was in trouble. One of them said that he was too exhausted to re-enter the water because of the rigours of the return swim, but the other discarded his tank and swam to offer help. The victim was now about 4.5 m (15 ft) from the jetty, unconscious and without tank and weight belt. He was brought out of the water and resuscitation attempted, but without success. It seems probable that death occurred before removal from the water. Check revealed that very little air remained in the tank. None of this trio had any buoyancy aid. Although the victim was accounted to be a fairly experienced diver, in fact, his 2 years of diving had been largely with hookah apparatus, and the statement that he was in good health was qualified by the doctor performing the autopsy who described him as obese. He was only 32 so this doctor was surprised that such a sudden death had occurred and suspected some cerebral haemorrhage and therefore limited his examination to the cranial cavity. As no such disease was found, drowning was diagnosed.

Case SC 76/8

This 45 year old man was diving for crayfish from a boat on this, his first open water dive. It is said that he had practiced diving a number of times on inland waters but his skill is unknown and neither is it known whether he received any instruction. The party consisted of one diver using a snorkel and three using scuba. The three scuba divers completed their dive and swam back to their boat, on the surface, the victim being the last in line. After boarding the boat they observed him floating face down on the surface. Although not really worried by this they decided to start the engine and go pick him up as he was quietly drifting away from them. After some delay occasioned by difficulty in raising the anchor they reached him. He was found to be unconscious so was taken into the boat and both EAR and ECC started, unfortunately without success. Autopsy revealed that a myocardial infarction, due to vascular disease, had occurred. No evidence about the victim's previous health was presented to the coroner.

3. Hose air supply diving (also called hookah or surface air supply) provided one tragic but very significant case. Those immediately involved were the unfortunate victims of a series of decisions made by others not present, in times long past, that had set up an unrecognised fail-fail situation. they merely made the final mistakes that completed the scenario.

Case H 76/1

This experienced and well trained diver was working with others from a regular dive boat attending to moorings. Only one diver was underwater at any time. The air was supplied from a double bank of 150 cu ft cylinders, two rows of five, kept protected (i.e. hidden) at the stern by a wooden cover. There were two lines from this bank, one being coiled on the deck and the other attached to the diver's harness for present use. A mouth-held demand valve was being used in connection with this hose supply and the diver wore a mask covering eyes and nose only. The water depth was 21 m (70 ft) and a total dive time of 30 minutes was allotted to each diver in turn, this allowing a generous safety margin for hard work component. The dive pattern was descent, attach lifting cables, ascend while lifting in progress and descent again for next attaching task till time was expired. Only one diver was underwater at any time. The man whose dive preceded that of the victim noticed that the gauge indicated

that the in-use cylinder was low so changed the attachment to a full cylinder. This change-over was not the specific responsibility of any designated person apparently. The victim entered the water and dived to the same pattern as all the others, making two surface excursions as required by the above plan. No variation in his actions from perfect normality was noted. When he failed to respond to even a second signal, and the absence of ascending bubbles was noted, the standby diver was immediately sent down to investigate. He found the victim lying on the harbour bottom minus his mouthpiece and unconscious. He was raised as rapidly as possible and resuscitation started using an Oxy-viva and ECC on the dive-boat. Although there were no definite signs of life attempts continued and the set's oxygen supply became exhausted so it became necessary to change to the large cylinder of oxygen that was aboard for just such an eventuality. It was now discovered that the oxygen cylinder was already coupled up to a hose, the diver's supply hose. Though resuscitation was continued during the trip to shore and onwards to a major hospital, it was unavailing.

Autopsy showed that death resulted from drowning, this following unconsciousness from breathing oxygen during work at 21 m (70 ft) depth.

The most immediate error in the chain of events was the connection of the incorrect gas supply to the diver's equipment. This occurred easily because only the cylinder valve was visible, the colour coded shoulder being hidden behind protective flooring. The only precaution taken against this type of mistake was the general knowledge among divers who were likely to dive from the boat that the oxygen bottle was always the bottom left one in the rack of the ten 150 cu ft cylinders. Naturally the reliance on traditional practices was immediately changed to a fail-safe method in that the oxygen cylinder was separated from the air cylinders from this time. Nevertheless the events could never have occurred had it not been possible to connect up the hose incorrectly. Hospital anaesthetic fatalities have amply demonstrated the imperative necessity for different thread sizes for each type of gas if machines are not to be wrongly connected up on occasions. Nitrogen and helium have elsewhere, it is believed, been supplied to divers with similarly fatal outcome. There are other (fire) dangers too if oxygen under pressure passes through incorrect fittings. Attention could well be given to this matter before a similar misadventure occurs in some other diving group. It is to be noted that this tragedy illustrated that it is unwise to assume that any procedure is safe merely because no accident has yet occurred. Only frequent positive reassessment of current diving practices will keep unsafe practices at bay.

Discussion

The primary lesson one can draw from these eleven case histories is that one can never afford to hold the sea in disrespect. It is necessary to be able to swim and to master a snorkel, a piece of equipment too little respected, even for calm water safety. The frequency of the fatal pattern of events developing in divers at the surface illustrates that one is not home and dry until safely out of the water and the dive plan must take account of this fact. The surface layer is the killing ground for those whose training and equipment are not up to the demands of the occasion, the rapidity with which death can occur making the prevention of the aspiration/unconsciousness/death progression preferable to an over optimistic belief in the efficiency of resuscitative measures in such casualties. Though reliable buoyancy vests were of value to several of the survivors, none of the victims had such aid. The failure to function of the vests of the two victims who had them confirm the belief of many that CO2 inflatable vests are liable to failure at the crisis time, which at the very least must be bad for the user's morale. Both cold water and worsening sea conditions are significantly noted by survivors and lack of buoyancy, with little or no remaining air, aggravate the risk of exhaustion and compounds the

problem of making a safe landfall.

In one case the fatality was due to a "heart attack" in a diver separated from his friends. This raises the question of fitness to dive. It is unfortunate that the victim's medical history is unavailable but the experience gained from the examination of Australian airline pilots over a ten year period has been that there is a poor predictive score from the routine examination and resting ECG when checked against later events. Of the twenty pilots in the study who suffered coronary thrombosis only one was "predicted" while three infarcts occurred unnoticed between routine ECG checks. Few of the pilots who were disqualified from flying on the basis of ECG changes were known to suffer a later coronary thrombosis. Of course no of this group had admitted symptoms. One other victim was said to be obese, with the implication of reduced fitness. Both these cases also involved significant factors additional to the health problems.

A better assessment of sea conditions, an adequate reserve of air in the tank for the return from the dive and a reliable buoyancy reserve are basic requirements for even the "certificated and experienced" who wish to reduce the odds against them. It is advisable to fit a submersible contents gauge, and be guided by it. Look before you leap into the water and as always, THINK.

Notes to Correspondents and Authors

Please type all correspondence and be certain to give your name and address even though they may not be for publication. Authors are requested to be considerate of the limited facilities for the redrawing of tables, graphs or illustrations and should provide same in a presentation suitable for photo-reproduction direct. Books, journals, notices of Symposia, etc will be given consideration for notice in this journal.

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DISCLAIMER

All opinions expressed are given in good faith and in all cases represent the views of the writer and not necessarily representative of the policy of SPUMS.

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TABLE 1

Case	Information Source	Age	Skill	Vest	Buddy	Air status	Brief notes:
BH 1/76	Inquest	26	nil	no	no	-	alone, 3ft deep, calm sea
BH 2/76	Depositions Report	24	slight	no	no	-	poor swimmer, calm sea, 44ft deep
SC 1/76	Depositions	45	slight	no	sepn	???	1st open water dive: CT.
SC 2/76	Depositions	36	C-card 1 year	no	sepn	off	surface, calm sea
SC 3/76	Inquest	40	C-card	no	no	full	professional diver killed by propellot
SC 4/76	Depositions Report	20	C-card	no	sepn	low	COLD, rough; waved for help, surface buddy vest
SC 5/76	Inquest	21	C-card	FAIL	sepn	satis	surfaced from 100ft; calls for help
SC 6/76	Depositions	55	30 yrs	FAIL	YES	satis	COLD; lost mask; washed off reef; rough water
SC 7/76	Depositions	32	slight (hookah)	no	sepn	empty	COLD; rough; dropped wts, tank; Surface
SC 8/76	Inquest	18	nil	no	YES	full	rough sea entry off rocks.
H 1/76	Inquest	23	trained	no	no	**	supplied oxygen at 70 ft

KEY:

Depositions = statements of witness as to police at incident time
 Inquest = witnesses with statements before the Coroner
 Report = direct "Stickybeak" report by a witness
 Buddy YES = Buddy present and active help all critical times
 Buddy sep. = Buddy separated at critical time of the incident
 Buddy no = dived or swam alone on the incident dive
 COLD = witness assessment that this a significant factor