

Resuscitation was commenced by a medical member of the group and the pupils responded quickly. It took 25 minutes of resuscitation, including intravenous adrenalin, before independent heart and respiratory activity were regained.

He remained unconscious, though making spontaneous movements.. There appeared to be some inability to use one arm in involuntary movements for the first two hours, but this apparently recovered. The patient remained irritable and made restless movements but did not seem conscious of his surroundings.

He was taken by boat to harbour as attempts to air-lift him with a helicopter were thwarted by a combination of communication problems, extreme range and sea conditions. He was transferred to an RAN patrol boat at sea which brought him to shore more rapidly than would have been possible on the dive boat. He was still very irritable and totally unconscious when carried ashore, though moving and responding to stimuli. He was transported breathing 100% oxygen by Royal Flying Doctor Service pressurized aircraft to the nearest recompression chamber where he was recompressed, initially on Table 6, thereafter to 6A with maximum extensions.

Great difficulty was experienced in controlling the patient, who was totally irrational and uncoordinated. Little improvement occurred during this recompression treatment. At the end his behaviour was such that he could occasionally drink and obey simple commands, but he objected to being handled and was even biting the attendants. He had received some intravenous fluids and steroids but because of his violence it was impossible to maintain an IV.

He was maintained on 100% oxygen and transferred to the nearest major recompression facility by pressurised aircraft the next day. There he was assessed and received further therapeutic recompression, but without making significant improvement. Over the next few days he received repeated recompression to 9 metres, with adjunctive therapy. Improvement was slow and did not appear to be related to treatment.

The patient was finally transferred to a neurological recovery unit, and three months later is making an excellent recovery. It is expected that he will be able to resume his work, which requires the accurate use of his mind, six months from the episode.

The history suggests that this patient sustained an acute air embolism, probably as a result of uncontrolled ascent, following some sort of underwater crisis. Cardiac arrest resulted. Resuscitation was effectively carried out, but due to the extreme remoteness of the site there was an interval of 26 hours before the patient was first recompressed. Oxygen was only available for a portion of that time. The final picture was that of global brain ischaemia, probably due to hypoxia associated with cardiac arrest. He is making the expected slow progressive recovery from this major insult.

NEW ZEALAND DIVING-RELATED FATALITIES 1981-82

Douglas Walker

Four breath-hold (snorkel using) divers and eleven scuba divers have been identified as dying in New Zealand waters while diving during 1981-1982. Five had been diving alone and all the remainder were to some degree separated from their companion(s) during the critical time, though in case SC 6 this separation was minimal and non-contributory to the fatal outcome of the victim's "heart attack". One victim was an epileptic with a history of survival from previous in-water attacks. Three victims had a history of asthma, but in none was this of proven significance. Cold water, rough seas, aspiration of vomit and possible nitrogen narcosis, were other factors noted. The available records were, in general, unhelpful in establishing the training and experience levels of the victims and rarely noted the diving skills of the other divers present. Police reports were available concerning the two cases where no Inquest was thought to be necessary.

CASE NOTES

Case BH 1

The victim was diving for paua and kina from a beach, the sea being too rough for the intended boat dive. The victim and his companion were diving independently of each other while a third person remained ashore. He saw the victim surface and became alarmed when there was no plume of water to indicate the snorkel was being cleared. He immediately entered the water, but had to return to the beach to better identify the victim's position before he could find him and bring him back to the beach. Resuscitation efforts were ineffective. The victim was an epileptic on medication and with a history of previous in-water fits from which he had recovered without ill effects. He was wearing shorts, shirt, jersey, sandals, mask and snorkel.

EPILEPSY. ALONE. SANDSHOES. NO FINS.

Case BH 2

Three friends went diving, two deciding to spearfish about 20 ft away from where the victim was to dive for paua. They last saw him alive as he sat on a rock, apparently about to re-enter the water. About 45 minutes later one of the spearfishermen came across the victim floating at the surface, face down, minus mask and snorkel. The water was cold and the victim had worn a shorty wet-suit for protection. Attempts at resuscitation were unsuccessful. They had had "a hard night out" the previous evening but blood alcohol was absent on test. Similarly, the history that the victim previously suffered asthma attacks appears to lack significance. As his diving skills and the water depth are alike unknown the possibility of hyperventilation as a factor cannot be evaluated.

SEPARATION. COLD(?). POST LATE-NIGHT FATIGUE(?). FOUND FLOATING.

Case BH 3

After a morning spent breath-hold diving the victim mentioned over his lunch that he felt seasick. Despite this

he insisted on resuming diving. He was later seen floating unconscious at the surface. He was brought ashore but failed to respond to resuscitative efforts. It was suggested as probable that he aspirated some vomit, then drowned. There was a history of mild asthma but nothing to suggest that it was in any way contributory to the tragedy.

SEASICKNESS. SEPARATION. ASPIRATION OF VOMIT.

Case BH 4

Diving in a 6 feet deep sea beach lagoon for kinoa, the two divers were unequally successful. The buddy handed his full bag to his companion, taking his in exchange. He told him to take it back to the shore while he obtained a few more kinoa. The water was calm but cold and the victim had only the protection of a wet-suit jacket. A short time later the buddy came across the other's snorkel floating on the surface, then noticed the victim floating face down at the surface about 20 feet away. He brought him ashore and attempted resuscitation, but without success.

SEPARATION. SURFACE. COLD. WET-SUIT JACKET ONLY. ALCOHOL. UNKNOWN EXPERIENCE.

Case SC 1

There was rough surf but the two men decided to kit up and try for some crayfish while their wives remained where they had just finished their picnic lunch. They swam out to just beyond the line of the breakers, where the leader made a short dive. He surfaced before the other made his descent and proposed that they abort the dive and return to the shore. They were swimming on the surface about 20 yards apart and finding it difficult to make progress in the rough surf when the buddy, by now in a mild panic state, noticed that the leader was seemingly resting with his compensator inflated and making no progress. He managed to reach him and found that he was lying on his back with his snorkel in his mouth but with its end underwater. He managed somehow to tow him to the beach where the two women helped him to get the victim ashore. Resuscitation attempts were commenced when they were beyond the surf, but were unsuccessful. The victim was an experienced diver but a tendency to get seasick in the water.

FAILURE TO RECOGNISE DANGEROUS SEA CONDITIONS. SEA SICKNESS. ASPIRATION OF VOMIT. SEPARATION. SURFACE. COMPENSATOR INFLATED. IMPERFECT REGULATOR PRODUCED WATER SPRAY ON INHALATION. VALIANT BUDDY ASSISTANCE.

Case SC 2

The victim and his friend attempted to hire two scuba sets to go spearfishing but the sports store manager would only sanction the hire of a single tank and regulator, for the use of the diver he knew to have been under instruction at one time. He gave strict orders that the scuba was not to be loaned to anyone else and made a point of stating that the contents gauge read high and needed to be discounted by 300 psi. He also briefly reviewed diving procedures. The two friends then went to the beach where the buddy scuba dived (alone!) and the other snorkelled. After a time they left the water and the buddy was persuaded to allow his friend to use the scuba in the still, clear waters of a nearby 15 foot deep rock pool. The victim wore a wet suit and all necessary equipment and seemed to be managing well so

the buddy decided to collect his spear gun and place it for safety in his nearby car, lest it be stolen. While at his car he heard his friend cry out, so raced back to the pool. There he found the victim floating face up at the surface, weight belt off and compensator inflated. Resuscitation attempts were unsuccessful. Investigation showed that the tank was empty though the gauge showed remaining air, as predicted. It is not known whether the victim had used scuba previously, as he had implied, but he was certainly untrained. He had a history of asthma and the pathologist reported signs of asthma reaction in the lungs, but no evidence of pulmonary barotrauma.

POOL SITUATION. UNTRAINED. INEXPERIENCED. OUT OF AIR. BORROWED/HIRED EQUIPMENT, USING ANOTHER'S AUTHORITY. ASTHMA BRONCHIAL CHANGES. KNOWN INACCURATE GAUGE. ALONE. VEST INFLATED. WEIGHT BELT DROPPED. BUDDY IGNORED WARNINGS ABOUT LOANING.

Case SC 3

After their first dive the victim told his buddy that he felt tired, but after a 15-20 minute rest in the boat declared himself ready for another dive. About 10 minutes into this dive the buddy suddenly realised that he was alone among the kelp, so surfaced. He found that the people who had remained in the boat had seen the victim floating at the surface and retrieved him. The sea was cold and choppy and his tank was empty. Autopsy revealed the presence of severe coronary artery disease, though there is no record of any check of his previous health record. It is supposed that despite having a contents gauge he ran out of air and made an emergency ascent, the stress/panic causing a fatal heart failure. He was untrained and inexperienced, though possibly the owner of the scuba he used (the point was not checked).

UNTRAINED. INEXPERIENCED. SEPARATED. OUT OF AIR. IGNORED CONTENTS GAUGE READING. ARTERIOSCLEROTIC (L) CORONARY ARTERY. FOUND FLOATING. COLD, CHOPPY WATER.

Case SC 4

This diver was last seen just before he dived near a buoy, 50 yards from the beach, when he waved to a person ashore. He is said to have been trained and experienced and in good health. When he failed to surface after an hour a search was commenced. His body was found near where he was last seen, the weight belt undone but retained by the lower strap of his compensator, which was (incorrectly) over it. The compensator was partly inflated but lacked the buoyancy necessary to surface the weighted body. There was adequate remaining air in the tank so the reason for the tragedy is unknown.

ALONE. WEIGHT BELT INCORRECTLY PLACED AND TRAPPED BY BELT OF PARTLY INFLATED COMPENSATOR. EXCESS ALCOHOL.

Case SC 5

The victim was a fisherman, trained but very inexperienced, who was diving alone to repair the shackles of a mooring. He was using borrowed scuba, though had a set of his own, and left a person in his boat when he dived with strict instructions to summon help if he failed to surface after 20 minutes. It is not known whether or not he regarded this as

NEW ZEALAND DIVING FATALITIES 1981 and 1982

CASE	AGE	SKILL	DIVE	DIVE	WATER DEPTH	WT BELT	CONT.	BUOY	EQUIP	REMAIN	EQUIP.	WET	COMMENTS
BH 1	23	T N/S E some	N/S N/S	2 sepn	beach	N/S	surface	no	N/A	N/A	own	no	Epileptic. Diving for paua, kinoa. Found floating. Separation. No fins.
BH 2	22	T N/S E N/S	N/S Expd	3 sepn	beach	N/S	surface	no	N/A	N/A	own	short	Cold. Diving for paua. Separation. Found floating. Asthma history.
BH 3	65	T N/S E N/S	N/A	alone	beach	N/S	surface	no	N/A	N/A	own	yes	No Inquest. Alone. Seasick. Aspiration vomit. Mild asthmatic.
BH 4	37	T N/S E expd?	N/S	2 sepn	beach	6ft	surface	no	N/A	N/A	own	jacket	Cold water. Diving for kinoa. Alcohol. Separation. Surface with full bag. Found floating.
SC 1	39	T N/S E expd	N/S N/S	2 sepn	beach	N/S	surface	yes	infl.	yes	full	yes	Rough sea. Aborted dive. Found floating. Aspiration of vomit. Valiant buddy. Minor regulator defect. Seasick
SC 2	33	T N/S E N/S	part some	2 sepn	rocks	15ft	N/S	drop	N/S	yes	empty	yes	Alone. Rock pool. Found floating. Inaccurate gauge. Asthmatic. Called out. Inflated compensator.
SC 3	31	T no E inexp.	yes expd	2 sepn	boat	35ft	N/S	N/S	yes	yes	empty	yes	Underwater separation. Found floating. Out of Out of air. Coronary artery disease.
SC 4	31	T ?? E ??	N/A	alone	beach	30ft	N/S	tangled	N/S	N/S	part infl	N/S	Inadequate information
SC 5	31	T yes E inexp.	N/A	alone	boat	20ft	ascent	on 22lb	yes	yes	1/2+ full	yes	Borrowed tank, had own. Sudden surface without mask. Ditched tank, not weights. Inexperienced. Probable AE.
SC 6	49	T N/S E N/S	N/S N/S	2 sepn	boat	60ft	surface	off	N/S	yes	low	yes	No inquest. Heart attack after surfaced.
SC 7	23	T N/S E Expd?	N/S N/S	4 sepn	beach	N/S	surface	off (buddy)	N/S	no	(full)	yes	Rough sea. Aborted dive. Group surface separation. Buddy valiant help. Loss consciousness. Inadequate information.
SC 8	26	T N/S E N/S	N/A	alone	boat	N/S	N/S	lost	N/S	Equipment not found	own	yes	
SC 9	34	T yes E inexp.	N/A	alone	shore	N/S	N/S	lost	N/S	yes	empty	yes	Strange delay starting search. Found floating. Rough sea No snorkel. Inexperienced
SC 10	34	T yes E expd.	N/S expd.	2 sepn	boat	180 ft	ascent	off (buddy)	N/S	yes	3/4 full	Jacket	Unexplained ascent. Separation. Unconscious before surfaced.
SC 11	27	T N/S E N/S	N/S N/S	2 sepn	boat	N/S	surface	on	N/S	no	1/2 full	yes	Surfaced in the path of a speedboat. In boat channel. No flag. Vest defective. Continued dive after separation.

KEY T = successful completion scuba course. E = reported degree of experience. N/S = Not stated. N/A Not applicable

a safety measure. He was seen to surface momentarily 5 minutes after starting his dive, then not seen further. When the 20 minutes had expired the alarm was raised and a search organised. His body was found on the seabed, minus mask and scuba unit but still wearing the weight belt. The tank was still nearly full. As the body was brought to the surface some regurgitation of a milk-shake taken shortly before the dive occurred, but no evidence of aspiration of gastric contents was noted at the autopsy. The story is typical of a panic ascent (cause unknown) with cerebral air embolism and consequent drowning, though no pulmonary barotrauma was noted by the pathologist. *INEXPERIENCED. ALONE. DITCHED TANK. RETAINED WEIGHT BELT. ADEQUATE AIR.*

Case SC 6

Careful diving practices were observed until the two divers surfaced and then decided to use up their remaining air beneath their boat, and the lapse, in that the buddy surfaced alone and got into the boat while his friend remained submerged, was probably not relevant to the outcome. The victim surfaced and handed his weight belt, mask and gloves into the boat, then suddenly clutched his chest and floated away. The buddy immediately jumped into the water and attempted to give EAR, but found it impossible and therefore (with great difficulty) got the victim into the boat. His resuscitation attempts were unsuccessful. Autopsy revealed evidence of previous myocardial damage and this death appears to have been due to a 'heart attack'. His health history is not known. *HEART ATTACK. PREVIOUS HEART ATTACK. BUDDY VALIANT RESCUE ATTEMPT. DIFFICULTY GETTING VICTIM INTO BOAT.*

Case SC 7

A group of four scuba divers swam out through the breakers using their snorkels in order to conserve their air. It is not known whether they had their air turned on. After swimming out about 100m the leader decided to abort the dive because of the rough sea conditions and they all started to swim back towards the beach, becoming scattered somewhat at this time. One of the party noticed the dive leader was floating at the surface about 40 feet distant, so swam to him. He then ditched the tank and weight belt of both himself and the victim in order to improve their buoyancy, for neither wore a compensator. In-water EAR was attempted before starting to tow the victim to the beach. Another of the group assisted with this towing. The victim was stated to be experienced but no facts are on record concerning training or experience of the divers involved.

SEVERE ADVERSE SEA CONDITIONS. GROUP SURFACE SWIM SEPARATION. NO COMPENSATOR. FAILURE TO USE SCUBA AIR. DROWNED. EXPERIENCE UNKNOWN.

Case SC 8

Very little is known about this incident (and background data will be welcome and useful) beyond the surprising facts that although his boat was discovered the day following his presumed date of death no alarm was raised about his absence until the fifth day. The body was washed up, minus all diving equipment, eight days after presumed death date. Nothing is recorded about his diving habits, experience, equipment or motivation.

ALONE. UNSTATED EXPERIENCE, TRAINING, DIVING MODE (SCUBA ASSUMED). UNEXPLAINED DELAY AT REPORTING MISSING. EQUIPMENT NOT RECOVERED.

Case SC 9

Two weeks after completing his basic scuba course, still very inexperienced, the victim made a solo dive to spearfish in rough seas. He left his snorkel in his car on the beach. About 4 1/2 hours later his body was found floating, his tank empty and compensator uninflated. Resuscitation was attempted, but unsuccessful. He had spent the previous evening at a late party but no alcohol was found in his blood. The weight belt had been dropped.

TRAINED. GROSS INEXPERIENCE. ROUGH SEA. ALONE. NO SNORKEL. OUT OF AIR. COMPENSATOR NOT INFLATED. DROPPED WEIGHT BELT.

Case SC 10

No explanation can be offered for the events of this incident, though nitrogen narcosis may have been the critical factor. There were about 14 divers on this boat dive trip and the buddy system of diving was being followed. He was trained and experienced, though it is not known whether he had deep-diving experience. Another buddy pair accompanied them to the pre-arranged depth of 180 feet, where the victim gave the signal for the ascent to commence. His buddy looked away for a moment to look at a rock formation, turning back to see the victim furiously finning upwards. He managed to catch up with him at about 130 feet, as he stopped his flippers and seemed to be resting there. Then he was seen to start to keel over backwards and to hold his arms out side ways from his body, the hands starting to shake. He fell back, landing on his back 20 feet lower, on a rock ledge. Initially his buddy thought the victim was fooling around but soon realised that he was in trouble. He ditched the victim's weight belt, held him upright, and part-inflated his own compensator to aid ascent. The demand valve remained in the victim's mouth and was seen to be bubbling air till about 10 feet from the surface. He was unconscious when surfaced. The dive boat was nearby and he was speedily taken on board. He did not respond to resuscitation attempts. No fault was found in the equipment and there was adequate remaining air. The first wild ascent, reason unknown, possibly resulted in an air embolism.

DEPTH. POSSIBLE NITROGEN NARCOSIS. UNEXPLAINED PANIC ASCENT. AIR EMBOLISM UNDERWATER (?). VALIANT BUDDY RESPONSE.

Case SC 11

Tragedy ended this outing by two couples. They took a boat and the two men scuba dived, then snorkelled, before they moved to anchor off a small island at the mouth of a bay, there to have lunch. Between them and the nearby rocky headland there was a marked boat channel. After their meal they decided to dive again, but became separated immediately they entered the water because of the poor visibility. About 10 minutes later one diver surfaced alongside the boat, and very shortly after this the other was seen to surface in the boat channel almost immediately in front of a boat towing a water skier. There was inadequate time for evasive action by either party and the diver was hit by the hull and possibly the propeller of the boat, sinking immediately. The buddy and one of those in the speedboat made an immediate search but failed to locate the body, which was recovered by a formal search later. Death was due to drowning after being critically injured.

It was admitted that those in the speedboat were in no way at fault, because they had kept as far from the moored boat as the channel allowed. No "divers down" flag was being flown because it had been torn the previous day and

awaited repair. The victim's equipment was checked and the tank found to contain adequate air: there was no imperative need for an ascent while a speedboat was obviously nearby. It was noted that he was wearing a defective compensator, the oral inflation tube having been torn off sometime previously and placed in the vest's pocket and the CO2 cylinder was empty. Neither diver had followed accepted teaching of immediate surfacing when separated from their buddy.

SEPARATION. POOR VISIBILITY. SURFACED DISTANT FROM DIVE BOAT. NO FLAG. DEFECTIVE COMPENSATOR. EXPERIENCE NOT STATED. DIVED NEAR MARKED BOAT CHANNEL. TRAUMA FROM SPEEDBOAT.

DISCUSSION

The most immediately singular finding in this short series has been the fact that nine of the victims were found floating, dead, as the first indication that anything untoward had occurred. In a further three cases the divers were diving alone, the bodies being recovered too late for any chance of reviving them. Of the remainder, one suffered a fatal "heart attack", another surfaced in the path of a speedboat and the third seemingly suffered an underwater pulmonary barotrauma with air embolism. Such events are more readily avoided than successfully managed. As no evidence is in the records concerning the previous health of the "cardiac" divers it is not possible to comment on whether they should have been diving.

The breath-hold fatalities seem to be representative of deaths in other years associated with seeking paua, kinoa, and other shellfish. In many such cases it is uncertain whether the victim was using mask and snorkel or without such aids. That a known epileptic with a history of having "turns" while diving should be allowed to continue to dive alone demonstrates either fatalism or a surprising belief in providence. Cold water was a possible factor in two cases, while alcohol, inhalation of vomit and fatigue following a previous "late night" were additional adverse factors noted. The history of asthma in three cases is of doubtful significance but will undoubtedly be thought to be of importance by some. All victims were alone at the critical time, though this was minimal and non-contributory to the outcome in case SC6, and in SC10 the victim's action created the separation.

During the two years here considered there were eleven Scuba diving deaths in New Zealand, which contrasts adversely with the twelve which occurred throughout the entire Australian seaboard in the same period. Although the available information is far from complete it is probable that the single most critical factor was inexperience, which gives hope that the toll can be reduced through education of the diving population. Case SC2 is a terrible reminder of the ease and rapidity with which a seemingly safe situation can progress irreversibly to a fatal conclusion. A calm, relatively shallow pool would seem to be a totally safe diving situation, but in the absence of knowledge and experience it became a death trap, the sensation of restricted air supply not being recognised as an urgent warning before the out-of-air situation was complete. The dive shop manager had done everything in his power to avoid

such an eventuality, leaving aside the question as to whether the hirer was sufficiently trained to be allowed to dive unsupervised (let alone alone). NEVER LOAN TO AN UNTRAINED PERSON!

Contents gauges were used on the equipment of seven of the eleven scuba divers, not used by one, and the situation is unknown in three cases. In three cases the user ran out of air, a known faulty reading gauge being a possible excuse in one, inexperience and lack of a snorkel in another.

The wearing of "compensators", type usually unstated, was noted in seven of the scuba deaths and none of the breath-hold ones. Full inflation of a compensator does not guarantee survival if there are sufficient adverse factors (cases SC1, 2, 11) but can be expected to favour survival. Diving with a non-functioning compensator has nothing to commend it.

It is noted that here, as in most previous such surveys, there are usually a number of adverse factors as well as the "trigger event". It is for this reason that diving instruction should always firmly inculcate into pupils the ongoing need to follow the guidelines for safe diving at all times. Do not pit yourself against the sea's power, dive with a buddy, surface with a useful reserve of air (ie. look at your gauge), have an efficient "compensator" (for choice inflated from a compressed air cylinder), and accept that fatigue, cold and narcosis are real dangers requiring respect. Naturally epilepsy, coronary artery disease (and asthma) should be absent factors. And fly the Diving Flag.

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DIVING SAFETY INVESTIGATION

Diving safety is improved by learning from the misadventures, both great and small, of divers. Much of value can be learnt from consideration of even seemingly minor problems experienced during dives. New Zealand readers are asked to make reports of such matters to the NZUA. Diving Incidents Scheme. Australian (and other) readers are asked to send reports to:

Dr Douglas Walker,
PO Box 120,
NARRABEEN NSW 2101
AUSTRALIA