

## *The Editor's Offering*

The Editor hopes that this issue of the South Pacific Underwater Medicine Society Journal has fewer errors than the June issue which went out with June on the cover but otherwise with September on every page. To add to this, the page to replace page 19 of the 1999 constitution still contained the words "of Censors" and "comprise individuals"! A corrected page is included with this Journal as is the 2002 Annual Scientific Meeting (ASM) booking brochure. The meeting will be held at the Iririki Island Resort in Port Vila in Vanuatu. For those who do not remember where Vanuatu is, it used to be known as the New Hebrides and is a group of islands to the north of New Caledonia and south of the Solomon Islands. The dates are, subject to airline flight changes, May 17th to 24th, 2000.

Much of this issue is taken up with discussion of clinical problems about fitness to dive. Readers will remember that this was the main topic of the 2000 ASM. A couple of problems which are seldom seen in recreational divers, dysbaric osteonecrosis and facial trauma from a speargun "pranger", get a mention and some coloured illustrations should hold the reader's attention. There is also a lovely picture of mask squeeze to remind us of what can happen if one overlooks equalising the mask space.

We have the latest report on Australian diving-related deaths (1998) by Douglas Walker, which includes a less than careful technical diving instructor who managed to kill himself by using the wrong gas, air instead of enriched air nitrox (EAN<sub>X</sub>). The report supports the comments by Des Gorman in the Fitness to dive panel discussion, that most diving deaths are due to human error.

Most of the Australian diving community know that abalone are shell fish which bring a high price when exported to Japan, but few know anything about the life and work of abalone divers. The 2000 ASM was introduced to this world by Graham Pollard, a South Australian abalone diver, who had changed his way of diving after developing decompression sickness which put him in the Royal Adelaide Hospital under the care of Des Gorman. He and his employees now use dry suits to keep warm, full facemasks providing communication with the boat, air supply from a bank of large cylinders and a bailout bottle, for the times when the diver is tethered to the bottom by kelp wrapped round his air line. A vast change from the bad old days when two South Australian abalone divers, diving without a boat keeper, died from carbon monoxide poisoning because the air intake for their compressor fell into the bottom of the boat next to the compressor engine exhaust.

In 1999 Bob Wong was able to persuade Western Australian abalone divers to co-operate in a survey of their diving habits and incidents. Much of the abalone diving is done in the Perth area where the water is shallow and here

the divers find life less surge affected if they walk along the bottom rather than swim.

Bob Wong and David Wright present a diagnostic puzzle for the reader to solve in **THE WORLD AS IT IS**.

We have been able to reprint a couple of papers (pages 175-179 and 180) which deal with a number of the points made in Fiji in 2000. Drs Stephen Glen, Steven White and James Douglas, all of the Scottish Sub-Aqua Club (SSAC), carried out a survey of just under 3,000 diving medical forms from SSAC divers, who had to have initial and subsequent diving medicals, and found that the yield of abnormalities from the medical was low and, to quote their words "Conditions that prevented subjects from diving were detected by the questionnaire and this prompted referral for further assessment by the medical advisers." The system in the UK is for untrained doctors to do diving medical using a questionnaire and medical examination form provided by the three major club diving organisations. Not every doctor reads the instructions that come with the form, so some of the passes are patently wrong.

The SSAC report led the UK Sport Diving Medical Committee, representing British Sub-Aqua Club, SSAC and the Sub Aqua Association, producing a new questionnaire so that the system could be changed and save time and money.

The British diving magazine **DIVER** provided a follow up to the SSAC paper, aimed at divers, in the May 2001 issue which is reprinted, unfortunately cut down to fit the space available, on page 180. The Clubs were considering acting on the SSAC report and changing the UK system to cut out the doctors untrained in diving medicine and having the clubs refer those few with suspicious answers to the questionnaire to diving medicine specialists. According to the August 2001 issue of **DIVER** the clubs decided to change to this system in June 2001.

Does this mean that the SPUMS policy of recommending that all divers should have a diving medical before they learn to dive should be dumped?

In the Editor's opinion it does not. The regular medicals, one on joining the club, the 5 yearly to the age of 40, then 3 yearly to 50 and then annually, are a cash discouragement to UK divers and their yield is low. The advantage of having a medical from a properly trained doctor before starting diving is that intelligent advice about diving and medical problems is available from the doctor. For follow up, questionnaires, as are being used in New Zealand for occupational divers, have advantages as experience has shown that they are filled in more honestly than diving medical forms! (*SPUMS J* 2001; 31 (1): 39-41)

## ORIGINAL PAPERS

### PROVISIONAL REPORT ON AUSTRALIAN DIVING-RELATED DEATHS IN 1998

Douglas Walker

#### Key Words

Accidents, deaths.

#### Summary

The deaths of eight snorkel users, nine divers using scuba and one using rebreather apparatus were identified. Each tragedy was individual but inexperience and overconfidence in personal ability were critical in some cases. It is to be noted that inexperienced users of snorkels can drown silently, close to others in shallow calm water, even when wearing a life-jacket, which unfortunately floats them face down.

#### Snorkel users and breath-hold divers

##### BH 98/1

This was the first time the victim had spearfished here, though he had often dived at other locations with this friend. Access was difficult, down a steep rocky hillside to a ledge. The buddy entered the water first, but waited for him to follow before they separated because the victim liked to hunt fish further out from shore than his buddy. When the buddy judged it was time to return to land he could not see his friend so assumed that he had already left the water, which would have been his usual practice. The climb back up the hillside was steep so when he failed to see his friend waiting on the rocks for him he assumed he had baulked at the climb and made his way back over the rocky shore. However he became anxious when the victim failed to rejoin him and dusk was falling, so called the police. A search found his speargun and float that evening, with the spear missing. Next day the body was found floating at 10 m with the weight belt in position. The belt was noted to lack a quick-release buckle, its end being threaded through the weights. There was a history of two operations on his back and of asthma, but no details of the latter's management or severity were available. The pathologist found no evidence of any acute asthma or cardiac disease at autopsy. Post-hyperventilation blackout was considered the probable critical factor, though his left ear drum was noted to be perforated and it was suggested that this might have been associated with vertigo leading to drowning.

EXPERIENCED SPEARFISHERMAN. LOST SPEAR. UNABLE TO DITCH WEIGHT BELT AS NO QUICK RELEASE BUCKLE. PROBABLE POST-

HYPERVENTILATION BLACKOUT. PERFORATED LEFT EARDRUM. HISTORY OF 2 OPERATIONS ON HIS BACK AND ASTHMA.

##### BH 98/2

While visiting from the USA this woman and her husband joined a day trip to view the Great Barrier Reef. She had snorkelled on previous occasions but was nevertheless somewhat anxious, afraid to be out of her depth. She not only remained in the shallows, where she could stand up, but also accepted the offer of a life-jacket aid for buoyancy. Her husband left her for a short time and on his return, intending to take her to a more interesting area, was unable to see her. He assumed that she had decided to become more adventurous and had swum to another area.

One of the staff was returning from a viewing of the reef with a group of the passengers when a child told him about a person floating nearby who was not moving. The child's mother had not regarded this information as significant but he decided to check. He found the victim floating face down. Resuscitation efforts were unsuccessful and complicated by regurgitation of fluid. It is obviously extremely difficult for a safety watcher to identify a swimmer in a crowd who gives no signal of distress.

SOME SNORKEL EXPERIENCE. ANXIOUS SO STAYED IN SHALLOW WATER. WEARING LIFE-JACKET. CALM WATER. SILENT SURFACE DEATH. CLOSE-BY SWIMMERS AND SAFETY WATCHER UNAWARE OF ANY PROBLEM. FLOATED FACE DOWN. CORONARY ARTERIES HEALTHY. VOMIT COMPLICATED CPR.

##### BH 98/3

After a day spent on his job of netting for sharks at a sealion colony, this man decided to dive to collect some abalone to make a meal for himself and his deckhand. They had seen few sharks that day although the area was known to have white pointers. He entered the water and was only about 3 m from the shore where the depth was about 3 m, when he surfaced obviously aware that there was a shark near. Then he was lifted from the water as the shark hit him. In response to his cry for help his boat hand bravely waded into the water and managed to pull him up onto the rocks. The shark remained close but did not attack again. Death from blood loss occurred before help could arrive.

SNORKEL DIVING SOLO FROM SHORE FOR ABALONE. AREA KNOWN FOR SEALIONS AND SHARKS. SHARK ATTACK CLOSE TO ROCKS. VALIANT RESCUE BY FRIEND. FATAL BLOOD LOSS.

**BH 98/4**

This 68 year old man and his wife were overseas visitors on a day trip to an off-shore resort island. All in the group were given a short talk on snorkelling before they were allowed to swim from the beach. There was one crew member on the beach as a safety watch and another in a boat outside the swimming area. Both the victim and his wife were wearing life-jackets, a safety option offered to members of the group. They were in calm shallow water, depth about 1 m, and close to about 15 others when his wife noticed he was floating face down and motionless close to her. He failed to respond to CPR efforts. No cardiac disease was found at autopsy. It is not known whether he had ever used a snorkel before.

POSSIBLY FIRST USE OF SNORKEL. CALM SHALLOW WATER. WEARING LIFE-JACKET. FOUND FLOATING FACE DOWN. SILENT RAPID DEATH NEAR OTHERS. NO EVIDENCE CARDIOVASCULAR DISEASE.

**BH 98/5**

Although he had to use a walking stick since a myocardial infarct (MI), this man was determined to snorkel to view the Barrier Reef. He joined a day trip to the reef. Those intending to snorkel were given a talk before wet suits etc. were issued. He mentioned that he had snorkelled some 20 years previously, but supposed equipment had changed since then. Water entry, using a ladder on each side of the boat, was supervised. He was the 12th and last into the water on his side of the boat. As he appeared to be apprehensive about putting his face underwater, the skipper suggested to a crew member that he should be given a life-jacket to wear, however this was not done. He was seen a short time later, by one of the passengers, swimming in a normal manner close to this ladder. It is uncertain whether he was wearing his mask and snorkel at that time. About 6 minutes later the skipper saw him floating face down close to the boat and failing to respond when the tip of his snorkel dipped below the surface. He was rapidly brought back aboard the boat but could not be revived. Autopsy showed there was significant coronary atherosclerosis and myocardial ventricular apical fibrosis from his previous MI so his death was ascribed to acute myocardial failure.

SNORKELLING. SOLO NEAR OTHERS. NO RECENT EXPERIENCE. APPEARED APPREHENSIVE. SILENT RAPID SURFACE DEATH. FOUND FLOATING FACE DOWN. DISABILITY FROM PREVIOUS MYOCARDIAL INFARCT. CARDIAC DEATH.

**BH 98/6**

Aware that his wife did not approve of his lack of fear of the sea and his habit of swimming outside flagged areas, he took care to avoid letting her know before he went fishing, swimming, or snorkelling. On this occasion he had

said he was going to some shops and might then go to the beach. Before he entered the water he asked a scuba diver who was coming ashore to mind his car keys, stating he would only be away for about 10 minutes. It was 40 minutes later when the diver noticed the passage of time, then saw a lifesaver on the beach giving CPR and realised the victim was the one whose keys he held. The lifesaver had been alerted by an anonymous phone caller and then seen the victim floating face down, mask displaced down around his neck, obviously dead. He was floating in rough water off rocks at the end of the beach. The significance of the high blood level of methamphetamine was not discussed. The reason he drowned is uncertain as no head injury or other disabling factor was identified.

SNORKELLING SOLO. ROUGH WATER NEAR ROCKS. HABIT OF UNSAFE SWIMMING CHOICES. FOUND FLOATING. TOXIC BLOOD LEVEL METHAMPHETAMINE.

**BH 98/7**

After he arrived at a resort island with his 2 children, this man hired a wet suit for himself and his son. He stated he had some snorkelling experience and was in good health. After booking for them both to join an organised snorkel swim that afternoon he inquired about safe areas of the beaches and was given directions. After about 45 minutes swimming here his son felt cold and returned to shore for a hot shower but his father remained snorkelling. A short time later another snorkeller saw a dark shape floating face down and found the person did not respond so turned him face up. It appeared the victim was dead but CPR was applied after the body was brought ashore. Autopsy revealed marked atherosclerosis of the coronary and basilar arteries. It was believed that this led to his cardiac related drowning death.

SNORKELLING SEPARATION. SOLO. SOME EXPERIENCE. SILENT DEATH. EXTENSIVE CORONARY ATHEROSCLEROSIS. CARDIAC DEATH.

**BH 98/8**

Attempts to obtain details of this tragedy have so far been unsuccessful. It is symptomatic of the lack of any proper understanding of the value of learning from the experiences of others that divers and diving organisations fail to support the reporting and investigation of diving related fatalities.

**Scuba user deaths****SC 98/1 and 98/2**

This double fatality received intense international attention because the two victims were left at sea and never recovered. They were very experienced and reportedly

## PROVISIONAL REPORT ON AUSTRALIAN

Case	Age	Training and Experience Victim	Training and Experience Buddy	Dive Group	Dive purpose	Depth in metres Water	Incident	Weights On	kg
BH 98/1	31	No training Experienced	No training Experienced	Buddy Separation before incident	Spear fishing	Not stated	Not stated	On	6 kg
BH 98/2	69	No training Some experience	No training Some experience	Group Separation before incident	Recreation	Not stated	Surface	None	Not applicable
BH 98/3	26	Training not stated Experience not stated	Not applicable	Solo	Abalone fishing	3 m	Surface	None	Not applicable
BH 98/4	68	No training No experience	No training No experience	Buddy Separation before incident	Recreation	1 m	Surface	None	Not applicable
BH 98/5	76	No training No experience	Not applicable	Solo	Recreation	Not stated	Surface	None	Not applicable
BH 98/6	32	No training Experienced	Not applicable	Solo	Recreation	Not stated	Surface	None	Not applicable
BH 98/7	51	No training Some experience	No training Experience not stated	Buddy Separation before incident	Recreation	3.5 m	Surface	None	Not applicable
BH 98/8	-	-	-	No information available	-	-	-	-	-
SC 98/1	33	Trained Experienced	Trained Experienced	Buddy Not separated	Recreation	Not stated	Surface	Not stated	Not stated
SC 98/2	30	Trained Experienced	Trained Experienced	Buddy Not separated	Recreation	Not stated	Surface	Not stated	Not stated
SC 98/3	46	Trained Experience not stated	Trained Experienced	Group Not separated	Recreation	15m	Surface	On	Not stated
SC 98/4	47	Some training No experience	Trained Experienced	Buddy Separation before incident	Recreation	6 m	6 m	On	9 kg
SC 98/5	42	Trained Experienced	Trained Experienced	Buddy Separation before incident	Recreation	48 m	48 m	On	Not stated
SC 98/6	49	Some training No experience	Trained + Experienced +	Buddy Not separated	Class dive	10.5 m	10.5 m	On	Not stated
SC 98/7	47	Trained Experienced	Trained Experienced	Buddy Separation before incident	Recreation	20.6 m	Ascent	On	9 kg

**DIVING RELATED DEATHS IN 1998**

<b>Buoyancy vest</b>	<b>Remaining air</b>	<b>Equipment Tested</b>	<b>Owner</b>	<b>Comments</b>
None	Not applicable	Not applicable	Own	Weight belt no quick release. Separation. Solo.
Life jacket	Not applicable	Not applicable	Hired	Wore lifejacket. Separation. Lack of confidence. Nervous.
None	Not applicable	Not applicable	Own	Shark attack near a sealion colony.
Life jacket	Not applicable	Not applicable	Hired	Wore lifejacket. First use of snorkel.
None	Not applicable	Not applicable	Hired	Apprehensive. Ill health. Rapid heart death at surface.
None	Not applicable	Not applicable	Own	Toxic methamphetamine blood level. Solo.
None	Not applicable	Not applicable	Hired	Separation as buddy was cold. Coronary artery disease.
-	-	-	-	No details available.
Not stated	Not stated	Not applicable	Own	Double fatality. Left at reef by dive boat. No body.
Not stated	Not stated	Not applicable	Own	Double fatality. Left at reef by dive boat. No body.
Buddy inflated	None	No faults	Hired	Current ++. Instructor towed. Arrhythmia death ?
Not inflated	Plenty	No faults	Hired	Heat stress. Solo entry into water. Lost demand valve from mouth at entry.
Not inflated	None	No faults	Own	Excessive depth/time, so out of air ascent. Unable to drop weights.
Not inflated	Plenty	Some adverse findings	Dive shop	Third dive. Hyperventilated. Controlled ascent. Unconscious at 7 m.
Partly inflated	Low	Some adverse findings	Own	Low air. Inverted buddy breathing ascent. Separation at 7 m. Obesity.

## PROVISIONAL REPORT ON AUSTRALIAN

Case	Age	Training and Experience		Dive Group	Dive Purpose	Depth in metres		Weights	
		Victim	Buddy			Water	Incident	On	kg
SC 98/8	46	Trained Experienced	Trained Experienced	Buddy separation before incident	Recreation	74m	Not stated	Off	Not stated
SC 98/9	48	Trained No experience	Not applicable	Solo	Recreational poaching	Not stated	Surface	Off	9 kg
RB 98/1	29	Trained Experienced	No training No experience	Buddy separation before incident	Instructor taking class	17.6 m	? 1 m	pouch weights not ditched	6 kg

careful divers, their main fault being to overstay their agreed dive time underwater. This, in concert with sloppy recording of the divers water entry and return times, resulted in a two day delay before their absence was admitted and the dive site revisited. This fatality occurred during a routine dive trip to the Barrier Reef on a boat the majority of whose passengers were making "resort dives" and snorkelling. This was their third scuba dive from the boat and there was deep water and strong currents around the bommie, which was within sight from the boat moored at a pontoon used by many dive boats. They chose to dive separately from the other scuba divers for this dive. After the dive there was a head count which was two short, but this was thought to be explained because two people had re-entered the water after being counted. The boat then made a silent departure from the dive site, and the finding of the victims' possessions on the boat after return to harbour and the disembarkment of the passengers failed to cause alarm, or even curiosity.

Intensive searches failed to find either victim, although some of their equipment was later washed up. There was comment at the inquest concerning some entries in a diary kept by one of the victims which could be taken to indicate depression in one diver, but possibly this did not give a true picture of the diver's state of mind. This diver was a poor swimmer, with poor sight, and if, as is likely, the two remained together this may have significantly reduced their chances of surviving. The boat had a quiet engine and the two divers underwater may not have heard it start up in preparation to leaving the dive area. It is thought that previous episodes of divers being forgotten and left at sea had occurred with other dive boat operators, though fortunately not with such tragic outcomes.

TWO EXPERIENCED SCUBA DIVERS. TENDED TO GREATLY OUTSTAY PLANNED DIVE TIMES. IMPERFECT LOGGING OF DIVERS IN AND OUT SO ANY FAILURE TO RETURN NOT NOTICED. TWO DAYS BEFORE THEIR ABSENCE WAS

REPORTED. CALM WARM WATER. STRONG CURRENTS. NO DESIGNATED DIVE MASTER. ONE WAS POOR SWIMMER WITH POOR SIGHT. BODIES NEVER RECOVERED.

**SC 98/3**

This man was a trained diver of unstated experience and was on holiday from the UK. Though he had suffered a middle ear barotrauma on a recent dive with this charter group, he was now recovered. On this occasion he was to be diving with three others, one an instructor, and they planned to ride back to the boat using the surface current. They commenced their return when all except the instructor were down to 100 bar. The underwater current had been strong and they had used their air faster than anticipated. They decided to swim back at 6 m to avoid the rough surface conditions which had now developed, but had insufficient air for the entire distance and were forced to surface after making a decompression stop. The instructor told them to inflate their buoyancy vests and use snorkels for the remainder of the return swim. But the victim became distressed after inhaling water down his snorkel and resumed using his regulator. The instructor decided to assist him and began to tow him. When about 20 m from the dive boat he reportedly said "still 70 bar", but soon afterwards said "no air" and when they were still 10 m from the boat he quietly became unconscious. He did not respond to their CPR efforts. At the autopsy his coronary arteries were found to be healthy so the pathologist diagnosed cardiac arrhythmia, followed by drowning, as the cause of death.

TRAINED SCUBA DIVER. UNSTATED EXPERIENCE. WELL MANAGED DIVE GROUP. RAPID RESPONSE TO DISTRESS DUE TO INHALED WATER DOWN SNORKEL. STRONG CURRENT. ROUGH SURFACE CONDITIONS. BUOYANCY VEST INFLATED. APPARENT ACUTE CARDIAC ARRHYTHMIA DEATH.

**DIVING RELATED DEATHS IN 1998 (Continued)**

<b>Buoyancy vest</b>	<b>Remaining air</b>	<b>Equipment Tested</b>	<b>Equipment Owner</b>	<b>Comments</b>
Partly inflated	None	Not tested	Own	Separation. Descent beyond the end of the shot line. No remaining air.
Not inflated	None	No faults	Dive shop	Solo. Abalone poaching. Catch bag unditchable. Out of air. Drowned at surface.
Not inflated	Empty when found	Some adverse findings	Dive shop	Inadequate care with gas testing. Air fill instead of enriched air nitrox (EAN) so hypoxia with exercise. Constant flow setting emptied tanks after his death.

**SC 98/4**

This tragedy illustrates the narrow window of time where training and experience can determine the outcome of an apparently simple problem. The victim had been informally trained by her husband, an instructor, and had made a total of 6 dives with him at a number of different locations.

On this hot day the 530 m walk from the car park to the water entry from the jetty caused a degree of heat stress. Water entry was singly, the next person waiting to allow the previous diver to swim clear. The victim stepped off the pier and submerged. Her husband, who had been standing behind her, waited to make his entry when she was clear. There was some delay before he stepped off the jetty as he had not completed his preparations. He became alarmed when he did not find her waiting at the surface for him. As he was starting to search for her a breath-hold diver saw her, dived down and easily brought her to the surface. He had found her on the sea bed, her snorkel held tightly in her mouth. Her husband had checked her equipment, and she his, before water entry. Because he was standing behind her he could not see her mouth and assumed she had the regulator in her mouth. Her air was turned on, her weight belt was on and her buoyancy vest was uninflated. It is probable that she lost her grip on the regulator during her entry and grabbed her snorkel mouthpiece in error, inhaling water when she took a deep breath. Although she responded sufficiently to CPR to reach hospital, she died there 3 days later from the anoxic brain damage she had suffered.

SOME INFORMAL SCUBA TRAINING. VERY INEXPERIENCED. 7th DIVE. SOME HEAT STRESS BEFORE SOLO WATER ENTRY. WATER ENTRY WITH UNINFLATED BCD. PROBABLY LOST REGULATOR FROM MOUTH DURING WATER ENTRY THEN MISTAKENLY GRABBED SNORKEL. DELAYED DEATH.

**SC 98/5**

There were four divers on the charter boat and three others. One was a diver who had an ear problem preventing him from diving, the other two owned the boat. Both were divers and one acted as the boat driver, the other as the dive master. He described the dive location to the quartet and then dived to fix a line from the anchor to the deep wreck (49 m) which was their objective. Although they had arranged to dive as two buddy pairs it was understood that this was a flexible arrangement.

One diver experienced ear problems and aborted his dive immediately after reaching the sea bed. Both the victim and his buddy had dived this wreck before and it was understood that the buddy would ascend sooner than the victim, who was carrying nitrox to reduce decompression time. The victim's failure to join his buddy at the deco bar and failure to surface alarmed the others. A bounce dive was made to look for him, though by then he would have been out of air. He was found lying free on the sea bed. His air tanks were empty, so his BCD could not be inflated. His weight belt could not be dropped because of the crutch strap. His dive computer showed he had ascended normally for 4 m, then rapidly a further 5-6 m before falling back to the sea bed. He had not attempted to use his nitrox supply. Both the victim, who carried a small tank of nitrox, and his buddy were using twin cylinders of air.

TRAINED. EXPERIENCED DEEP DIVER. GROUP PLANNED TO IGNORE BUDDY DIVE PROTOCOLS. ONE DIVER ABORTED WITH EAR PROBLEM. HIS BUDDY CONTINUED SOLO. VICTIM LET HIS BUDDY ASCEND SOLO. WEARING DRY SUIT. TWIN TANKS AIR. ALSO SMALL NITROX TANK FOR DECOMPRESSION. SLOW ASCENT FOR 4 m. THEN RAPID 5 m. THEN SANK TO SEA BED. OUT OF AIR. FAILED USE HIS NITROX. WEIGHT BELT ON.

**SC 98/6**

Two friends from overseas intended to dive on the Barrier Reef. One had proof of training but the victim had only made one pool and one open water dive previously so was required to have a Diving Medical check before acceptance for a live-aboard dive course. The victim's friend owned the bar he had visited for about 4 hours, 4-5 times a week for the past 6 years. He told the doctor this friend was a non-smoker, but had only ceased for 3 months. He was found to be moderately overweight and to have mild hypertension, which appeared to be a tension response.

During the course he dived with the instructor to perform mask clearing, don and doff exercises on the sea floor and was then asked to do a "fin turn" but failed to respond. Then he was seen to be taking rapid, shallow breaths. They started to ascend in close contact then at 6 m he suddenly became limp and was unconscious as the instructor brought him to the surface. Resuscitation attempts were unsuccessful. At the autopsy there was no evidence of either cardiac disease or CAGE so the cause of this fatality is undecided. No equipment faults were present.

THIRD DIVE OF SCUBA COURSE. WITH INSTRUCTOR. UNEXPLAINED ONSET RAPID SHALLOW BREATHING. CLOSE CONTACT ASCENT WITH INSTRUCTOR. BECAME UNCONSCIOUS AT 6 m. HISTORY OF HIGH BEER INTAKE. SMOKER TILL 3 MONTHS BEFORE. LABILE BLOOD PRESSURE NOTED. NO EVIDENCE CARDIAC DISEASE OR CAGE PATHOLOGY. REASON FOR INCIDENT AND DEATH UNKNOWN.

**SC 98/7**

A group of six divers arranged an interstate 3 day, 6 dives, land based dive package with a dive shop. All were experienced divers and they made the planned 2 dives a day on the first two days without incident. On the first dive of the third day the dive boat, skippered by a dive master, took them to the chosen location and they had the local conditions described. The dive master himself was not to dive. There were divers from another group diving nearby but closer to the rocky islet than their boat.

The victim and his buddy were at 15 m and 32 minutes into their dive when the buddy noted his air was down to 100 bar and that his companion had only 50 bar. They decided to ascend, the victim breathing from the buddy's supply to conserve his own air. At 7 m the victim was a little above his buddy, the air donor, and inverted. This prevented his BCD from venting. The buddy was also unable to vent his BCD to slow his ascent because the ball was missing from the end of the vent lanyard and without it he could not grip the lanyard adequately. To escape this situation they ceased buddy breathing and separated. The victim resumed using his own regulator but continued his inverted ascent uninterrupted. The buddy now descended

to 5 m depth to make a deco stop but the other continued directly to the surface. The dive master, in the boat, saw the victim at the surface and exchanged "OK" signals with him, then saw him swimming on his back towards the dive boat. He became uneasy and called to the buddy to swim to him when he saw him turn over, face down, his body turned a little on one side. He was found to have blood and water in his mask and to be unconscious when reached. He appeared to be dead. Resuscitation efforts were unavailing.

Although pre-autopsy films showed some air in his heart the pathologist was more impressed by the finding of narrowing to 10-20% of normal in one coronary vessel, and the evidence of drowning. There was no clear evidence of myocardial ischaemia. Clinically this was a CAGE fatality, brought about by the failure of the buddy breathing and inability of the victim to vent his BCD and thereby stop his uncontrolled ascent. It was possibly inappropriate to initiate buddy breathing if they were at 15 m and he had 50 bar, but they may have been planning for the deco stop rather than merely reaching the surface.

EXPERIENCED SCUBA DIVER. LOW AIR. DECISION TO BUDDY BREATHE DURING ASCENT. UNABLE TO VENT AIR FROM BCD. SO FASTER ASCENT THAN BUDDY LED TO INVERSION. THEN TO UNCONTROLLED ASCENT AFTER BUDDY BREATHING CEASED. SEPARATION. SURFACE OK SIGNAL AND SWIM BEFORE SILENT DEATH. EQUIPMENT FACTOR SIGNIFICANT. ONE VESSEL CORONARY NARROWING. CLINICALLY AND RADIOLOGICALLY CAGE.

**SC 98/8**

The organisation which ran this live aboard 5 day diving cruise was very safety conscious. All divers had to prove their competence, either by a record of 50 dives or of dives made within the previous 6 months. This woman held an Advanced Diver card and had made 35 dives and was "passed" after making a test dive with a dive master. She was then assigned a buddy, but after their first dive the buddy asked for a change, claiming that she was self centred and took no interest in her buddy, used excessive air but failed to check her own contents gauge. However there were no complaints after the group drift dive later that day, and she chose not to join the night dive.

The next day she was paired with a recently trained diver for a dive on the nearby reef. The current was checked by one of the instructors and they were assured it was not too strong and would assist their return after their dive. However the victim started her dive without waiting for her buddy and was soon out of sight as the visibility was poor. The buddy experienced sinus and ear barotrauma pain during descent and decided to abort his dive, though he had by then reached 18 m. During his ascent she rejoined him and when they surfaced they found a strong current was taking



them away from the dive boat. They were unable to attract the attention of anyone on the boat despite yelling and using a "safety sausage" (the first one they tried was faulty). The crew were at that time too busy assisting divers enter the water. The buddy decided to await rescue, holding an inflated sausage, which was leaking and became limp, but the victim chose to dive again and was soon out of sight. The buddy was soon joined by another diver whose sausage also was faulty. They remained calm and were ultimately located by an air search. The victim's body was also found on the surface, weight belt off, BCD part inflated and tank empty. There was no evidence of CAGE or coronary disease, though there was an old myocardial scar, the liver was fatty and there was a thyroid adenoma.

TRAINED. EXPERIENCED. ADVANCED DIVER. OVER CONFIDENT. IGNORED BUDDY. USED MUCH AIR BUT FAILED TO CHECK CONTENTS GAUGE. STRONG CURRENT. WASHED AWAY. "SAFETY SAUSAGES" FAULTY. LEFT BUDDY AT SURFACE AND MADE SOLO DIVE. FOUND DEAD AT SURFACE. OUT OF AIR. PART INFLATED BCD. DITCHED WEIGHT BELT.

#### SC 98/9

There are regulations restricting the number of abalone which a diver can collect but these are not universally respected. This man had completed his course 16 months previously but this was the first dive he had attempted since then. He was fully confident of his ability, however, telling his wife that he would not have passed the course if he was not competent. It is believed that he was not confident using a snorkel. He hired a tank, the remainder of his equipment being his own, attached a catch bag to his waist, and made his water entry off rocks into a calm sea. It was over an hour later that was seen to surface a short way off the rocks and wave one arm, then his head fell limp and he floated face down at the surface. An attempt was made to catch hold of him as he was washed past to the rocks but the water was now rough and he was swept from the grasp of his would-be rescuers. The body was recovered by a crewman dropped from a rescue helicopter. His tank was empty, weight belt missing, and a bag full of abalone (in water weight about 5 kg) hung from his waist.

The cause of death was drowning and the police investigation showed that it was probable that he would have floated vertical with his mouth above the surface if he could have ditched the abalone. He could have survived had he used his snorkel or had air remaining in his tank. Although he had a reported recent cough this was probably a minor adverse factor in this fatality.

TRAINED. FIRST DIVE FOR 18 MONTHS AFTER COURSE. SOLO. OUT OF AIR. UNABLE TO DITCH BAG OF ABALONE. DITCHED WEIGHT BELT. ROUGH WATER. POSSIBLY SOME AIR IN BCD.

#### Rebreather user

#### RB 98/1

Before this small dive cruise charter company could start offering courses in nitrox and rebreather diving it sent its diving instructor, who held a recent Nitrox Instructor qualification, and two others of its staff for a course in the rebreather's use. This was a condition before the supplier would deliver the equipment. They had, in total, made 14 dives using the equipment before this, the first commercial course. The first two pupils were experienced divers, one of whom took an Advanced Diver course before commencing the rebreather and nitrox course. The instructor was a very experienced scuba diver but of limited teaching experience. There is concern about the thoroughness of the nitrox course the instructor had taken, as both lecture and dive times appear to have been less than those officially required. After installation on the boat of the Nitrox Membrane Undersea Breathing System a technician came to instruct in its use. The crewman who was to operate it was absent so the instructor was informed directly, and was made aware of the importance of using the correct valves and purging the lines when changing air to/from nitrox production. It is believed he was not obsessive in such matters. Indeed radio advice had later to be obtained concerning operating the compressor.

They made four scuba dives the first day and two, to 31 and 26 metres, the next morning. Following these the instructor gave an apparently short talk on nitrox and the rebreather equipment. There was then a short introductory dive during which his three pupils (the deck hand, a trainee dive master, was in the group) found the gas supply appeared inadequate. The instructor assured them they would find the supply better as they dived deeper, which they later found to be true. The regulations require the introductory dive to be made in sheltered water, not the open sea. It was later noted that all these dives were poorly recorded. Their second dive was to 8-10 m for 15 minutes, without a shot line, "in a manageable current". The instructor was observed to test the tank gas mix initially and check the tanks were turned on the first two dives. The deck hand particularly noted the latter detail as the instructor was known to forget to turn his tank air on before entering the water. They returned to the dive boat after each dive.

Having made two short excursions using the equipment they re-entered the water. The current had increased and the deck hand turned his own nitrox tank on and descended solo to 5-6 m but was unable to make any headway against the current to reach the line, became short of breath and used his pony bottle air to ascend. He saw the instructor descend without taking notice of him. The two others experienced a similar problem with the current and also returned to the surface. The dinghy picked them up and as they returned to the dive boat they saw the instructor swimming about 1 m below them. The deck hand found it difficult to maintain himself at the surface as he was unable

to inflate his BCD and never thought to drop his weights. Incorrect alignment of the inflator hose was later found to have caused his BCD problem. Despite the short interval of time between sighting the instructor swimming and the divers being taken aboard the boat there was no further sighting. The body was found by searchers next day lying on the sea bed at 27 m. The weights had not been ditched and the tanks supplying his rebreather with continuous flow were empty. It is therefore not possible to determine how soon after the last sighting he drowned.

Examination of the equipment showed that his nitrox tank contained air and that one of the two mix jets was blocked by zinc carbonate, this reducing the gas flow to below the manufacturer's specifications. As the set was not designed to use air these two factors would result in hypoxia in the user. In addition the carbon dioxide container was incompletely filled. The cause of death was drowning, a consequence of loss of consciousness due to hypoxia. The three others survived because they aborted their dives sufficiently early, before becoming too hypoxic. It was found that the tank was filled with air rather than nitrox because he had failed to connect the supply line from the nitrox storage cylinder to the line he used to fill the tanks. It is assumed that all the tanks incorrectly contained air and that his observed test of the tank contents was incompetent.

EXPERIENCED SCUBA DIVER. INSTRUCTOR. RECENT TRAINING AS NITROX AND REBREATHING INSTRUCTOR POSSIBLY FAULTY. FAILED TO CORRECTLY USE NITROX FILLING SYSTEM OR TEST GAS FILL IN TANKS. CARELESS. HISTORY OF FAILING TO CHECK OWN TANK TURNED ON BEFORE WATER ENTRY. ERROR OF OPEN WATER INTRODUCTORY DIVE WITH STUDENTS. EQUIPMENT CHECK FAULTY ON STUDENT. EQUIPMENT FAULTS. FAILED TO RESPOND TO PUPILS PROBLEM OF INADEQUATE AIR SUPPLY. STRONG CURRENT FACTOR SAVED PUPILS. LEFT HIS STUDENTS. ANOXIA THEN DROWNED.

## Discussion

Information is available on seven persons who died while using snorkels. Of these three were experienced users and the critical factors were post hyperventilation blackout, a shark attack, and probable conjunction of rough water and drugs. Experienced spear fishers will always risk blackout when they allow their endeavours to over-ride their body's warning signals. The additional factors in this case of asthma and back problems do not appear to have been critical. Although shark attacks are rare and unpredictable, they are most likely in areas where seals and sea lions are present, as in this case. The third experienced diver who drowned had an unwise diving behaviour pattern, a liking for solo diving and rough water. Whether or not the drug level critically effected his behaviour cannot be known, but

it undoubtedly cannot have been beneficial. The reason for his death on this occasion on this dive can never be known.

All the remaining snorkel users were very inexperienced, and two were sufficiently anxious to wear a buoyancy jacket, while a third was thought to need one. Unfortunately these floated their wearers face down. Cardiac factors were the probable critical event in three cases, with panic in shallow water the likely factor in one. Three of the scuba users were significantly inexperienced, but apparently all were confident of their diving ability. The story of SC 98/4 is particularly tragic, as she made a water entry from a jetty with her husband standing behind her ready to follow. There were several factors conspiring to her drowning, an uninflated BCD, loss of regulator from her mouth and her replacing it with her snorkel in error, and the possible respiratory shock of change from the hot jetty into water cold by comparison. In SC 98/6 the sudden change to rapid shallow breathing and then death while ascending accompanied by his diving instructor is difficult to explain in the absence of significant autopsy findings. Case SC 98/9 illustrates the problem of those who believe their certification is proof they are expert divers, even though they fail to use their training after their course. Additional adverse factors were being solo, running out of air, unwillingness to use a snorkel and tying the catch bag around his waist. Avoidance of any one of these factors might have saved his life.

There were five instances where the victims were experienced, the best publicised being the double fatality where a couple were not only left at sea but their absence went unadmitted for two days. One of the victims was described as being a poor swimmer with poor eyesight, factors reducing their chance of survival. This incident shows a clear breach of basic supervision responsibilities. It is suspected that similar "left at sea" events have happened previously but, fortunately, the divers involved were recovered unharmed by other dive boats. In case SC 98/5 the diver was experienced in deep diving and had indeed brought a small tank of nitrox mix with him to allow him a slightly increased time on the wreck and reduce his deco stop time. He informed his buddy of his plan and the buddy in consequence commenced his ascent without him. This broke a buddy pair into two solo divers at depth. The buddy became worried by the failure of his friend to join him or surface. A search recovered the missing man, whose air tanks were empty. His gauge showed he had ascended 4 m then sunk back to the sea bed. In his out-of-air state he never thought to drop his weight belt or to use his nitrox supply so had no chance of survival.

In case SC 98/7 the victim similarly allowed a low-air situation to develop, then attempted to save his air by making a buddy breathing ascent. During this he was head down so unable to vent his BCD, and unfortunately his buddy's dump valve lanyard was without a ball to grasp, so was unable to be operated. They recognised the danger of

too rapid an ascent so separated. The victim reached the surface and appeared well initially, then lost consciousness. This was clinically a cerebral gas embolism scenario, though not confirmed at autopsy. Dive discipline does not appeal to all but may nevertheless have survival benefits, as in case SC 98/8. Here the dive organiser was safety conscious and checked the recent dive experience of those on the live aboard dive boat. However no "warning bells" rang when the victim's first buddy refused to dive again with her because she ignored her buddy, did not check her contents gauge and used excessive air. On the fatal dive she failed to wait for her allotted buddy, whose later descent was aborted through sinus squeeze. Remarkably she rejoined her buddy and they surfaced together to find themselves in a current. Their "safety sausages" were faulty and dive boat slow to recognise and respond to their signals. She apparently became impatient and dived again, leaving her buddy. Her body was later found floating, tank empty and some air in her BCD. There was evidence of a past myocardial infarction but no evidence of either a gas embolism or further cardiac event.

The experience of the diver in SC 98/3 is unknown. He and his two buddies ascended when he was low on air during their return swim. The dive leader, an instructor, suggested they snorkel back the remaining distance, but he aspirated some water and resumed using his scuba regulator. The instructor had begun to tow him but before reaching the dive boat he said "no air" and lost consciousness. In the absence of apparent cardiac disease, the pathologist suggested the cause of death was cardiac arrhythmia.

It is clear that running out of air remains a potentially fatal event, as also is overconfidence in one's diving ability, and that being solo is arguably unwise. The responsibility to perform a correct head count remains a responsibility dive masters neglect at risk to their divers' safety. The old basic rules for safer diving still remain valid.

### Acknowledgements

This investigation would not be possible without the understanding and support of the Law, Justice or Attorney General's Department in each State, the Coroners and police when they are approached for assistance.

### PROJECT STICKYBEAK

Readers are asked to assist this safety project by contacting the author with information, however tenuous, of serious or fatal incidents involving persons using a snorkel, scuba, hose supply or any form of rebreather apparatus. All communications are treated as being medically confidential. The information is essential if such incidents are to be identified and the causes brought to the attention of those involved in diving safety and diving training. **See back cover for address to write to.**

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### ABALONE DIVING IN WESTERN AUSTRALIA DIVING PRACTICES IN 1999

Robert M Wong

#### Key Words

Abalone, occupational diving.

#### Introduction

Abalone divers are only one group of Australian diving fishermen. They work in New South Wales, South Australia, Tasmania, Victoria and Western Australia, diving mostly in shallow water. This is not always possible because of overfishing in past years and the activities of poachers who do not have abalone licences. Other groups of diving fishermen include pearl divers, who have been working in Western Australia, the Northern Territory and Queensland for over 100 years; divers on Tasmanian salmon farms, where the salmon are fattened in moored nets, since the 1980s; divers doing the same sort of work and more for the tuna farms in South Australia since the 1990s; and other divers who collect tropical fish, periwinkles, and other shellfish.

#### Abalone diving

In the early years of Australian abalone diving (1960s-1970s) there was no regulation of abalone fishing and as a result divers went deeper and deeper as enthusiastic collecting stripped the shallower waters. In this era there were many diving accidents (decompression sickness and cerebral arterial gas embolism after emergency ascents when the compressor stopped) and a number of deaths from the bends. The most horrific were in 1972 in Mallacoota, Victoria, where two poachers from New South Wales, where divers were not licensed, died in the chamber after days under pressure. Shortly afterwards the Victorian Government refused to renew single abalone diver licences, requiring the applicant to purchase an extra licence from another diver who would then have to leave the industry. This and the introduction of quotas reduced the need for divers to take as many risks as they had done and, with an

TABLE 1

## ESTIMATED NUMBERS OF AUSTRALIAN ABALONE DIVERS

	1980s	1999
Tasmania	125	125
NSW	57	35
Victoria	90	70
South Australia	35	45
Western Australia	14	26

education drive about the need for decompression, led to safer diving practices. Table 1 gives estimates of the number of abalone divers in the 1980s and in 1999.

The diving pattern on the East Coast in 1980s was said to be 60 feet (18 m) for about 60 minutes then ascend at 60 ft/minute (18 m/minute) with a decompression stop at 10 ft (3 m) for 5 minutes. Surface intervals were short with the second dive to 40 ft (13 msw) for 1.5 hours and the third to 20 feet (6 msw) for up to some hours.

However the diving practices of that time have also been described as the first dive starting soon after arrival at the dive site. It lasted until lunch time or the site was fished out, with an ascent to the surface every time a bag was full of abalone or the compressor motor ran out of fuel. After lunch the diver might move into shallower water and repeat the process until it was time to go to shore.

Divers in southern waters worked between 4 to 12 hours a day, weather permitting, in water temperatures of 9°C in winter and 16°C in summer.

Once quotas were introduced abalone could be sold only to licensed processors and direct sale to restaurants or fish shops was made illegal. This of course did not stop poaching, but the amount of overfishing was reduced.

### Western Australia

Fishing for abalone in Western Australia on a commercial scale began in 1968. Divers, who were mainly self-taught, used surface supplied "hookah" systems. This simple system consists of a petrol driven compressor, usually but not always, supplying a reservoir holding compressed air, with a hose to a second stage regulator in the diver's mouth. Usually there was one diver with one tender in each boat. The divers followed no scientific decompression profiles. Decompression sickness (DCS), often unrecognised, was common and minor symptoms were usually ignored. In-water recompression was occasionally used. Only serious cases impossible to ignore, such as paralysis, were treated in a recompression facility.

TABLE 2

## DEMOGRAPHICS OF WESTERN AUSTRALIAN ABALONE DIVERS (1980S)

	Average	Range
Age	38.1	(23-63)
Years of diving	16.1	(0.4-35)
Years of abalone diving	12.1	(0.1-31)
Hours diving/day	5.2	(1.5-9)
Days/year	105.8	(28-200)
Max depth average day	15 m	(4.5-30 m)
Treated DCS incidence	4.1 a year	

Before a quota system was introduced in 1987, divers dived as much as possible to maximise their income. Before the quota system divers were in the water for 5-8 hours a day, with surface intervals of only 10 minutes and a total surface time of 60 minutes per day. Diving was restricted only by the weather and was encouraged by rising prices. Once quotas were introduced incomes were limited and the intensity of diving was reduced. It now averages 45 days per year, when two dives are done per day and diving lasts up to 4 to 5 consecutive days.

Table 2 gives the demographics of Western Australian abalone divers in the 1980s

In Western Australia the quota system was introduced in 1987. Regulation was introduced by the Department of Fisheries to control the "catch rate". However, no information was collected on DCS incidence or dysbaric osteonecrosis (DON) by the Department.

The divers' incomes depend on the size of their quotas and whether they can reach the quota limit, which may be impossible owing to bad weather. In Western Australia a licence which was worth \$Aust 250,000 in 1984 was worth \$Aust 3,000,000 in 1999. The price paid to the divers by licenced abalone processors varied between \$35 and \$50 a kilo, fresh in the shell, in Melbourne during June and July 2001. In 1964 the Melbourne price was 2 shillings and 5 pence a pound (55 cents per kilo) for cleaned, shelled, salted and drained abalone.

The West Australian quota system also introduced zones for licences and quotas. Zone 1 runs from the South Australian border to Esperance, Zone 2 from Esperance to Busselton and Zone 3 covers the area north of Busselton. In early 2000 there were 26 licence holders, 6 in Zone 1, 8 in Zone 2 and 12 in Zone 3.

Three species of abalone (*Haliotis*) are harvested. In 1999 Greenlip (*H. laevigata*), minimum legal size 140 mm across the shell, provided 5 tonnes of meat, Blacklip

(*H conicopora*) minimum size 140 mm gave 1.2 tonnes of meat and Roe's abalone (*H roei*) 70 mm across the shell were harvested for 1.7 tonnes unshelled weight.

Western Australia abalone divers co-operated with a survey conducted by the author in 1999 to obtain information about their current dive practices and the changes that have occurred over the years.

The survey showed that the depth of dives ranged from 6 m to over 30 m, with an average of 20 m. As in the past, most divers were not trained, although some had undergone recreational diving training. Some experimented with enriched air nitrox, with one case of oxygen toxicity reported. Some use oxygen empirically. The majority of the divers relied on dive computers. Some divers stated that they adopted the pearling industry's dive techniques using a very slow rate of ascent and oxygen decompression. Alternative air supplies or communications were not used, which resulted in one death from entanglement in 1998.

### 1999 Overview Zone 1

Before the introduction of the quota system, the divers in Zone 1 dived a minimum of 6 to 7 hours a day. It took an average of 20 minute to fill the neck bag, then the diver would ascend and descend again with or without any surface interval. If there was one it would last about 15 minutes. They made use of the "SOS" meter, an early decompression gauge containing a gas filled bladder. Underwater the increased pressure forced gas through a ceramic filter so simulating gas uptake. Green was safe to ascend and red required decompression time. No oxygen was used.

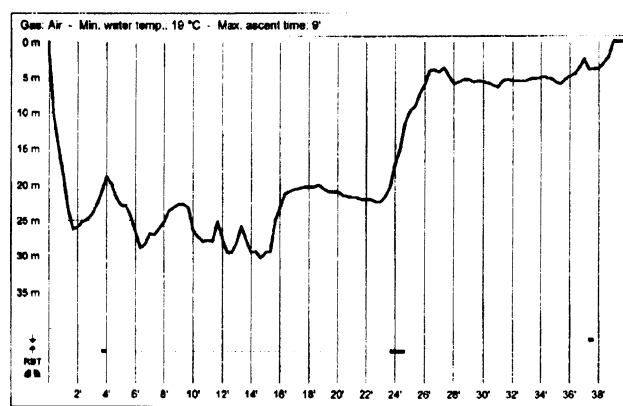
In 1999 there were six divers, three in their 20s, two in their 30s and one over 50, working in Zone 1. Their training was self-taught, recreational and on-the-job training. They dived mostly using hookah, but about 7% of dives were done using oxygen enriched air nitrox (EAN) on scuba. This is more expensive than using hookah, but is less likely to cause DCS if used using air tables. Alternatively it can allow longer underwater times when using a nitrox computer and equivalent air depths (EAD). Some divers used a "scooter", either battery or hydraulically powered. Some used a shark cage while others wore a shark pod (a South African shark repelling device).

To keep warm they used hot water heated 8 mm wet suits. The simplest and least efficient system is to pour hot water into the wet suit before diving. More efficient is to run water from the boat engine's cooling system through a hose into the wet suit. Heat control was provided by having a copper tube covered by insulation, which can be moved to adjust the temperature of water entering the diver's wet suit, near the diver's end of the hose. Water temperatures vary between 15 and 21°C.

About 10% of the dives were shallower than 10 m, 40% between 10 and 20 m, 50% between 20 and 30 m and only 1% between 30 and 40 m.

They averaged 80 days diving per year with average in-water times of 4.5-5.5 hours and 4-5 dives with an average bottom time of 40 minutes. Surface intervals were usually 30-45 minutes. Reverse dive profiles occurred in approximately 25% of the dives, depending on the availability of abalone and dive site depths.

Divers commonly used a dive computer, often the "Aladin Pro". Decompression stops were seldom used. Some divers ascended at "no faster than the smallest bubbles" while some computer records showed 5-6 m/minute. Figures 1 to 3 show computer printouts of typical dives.



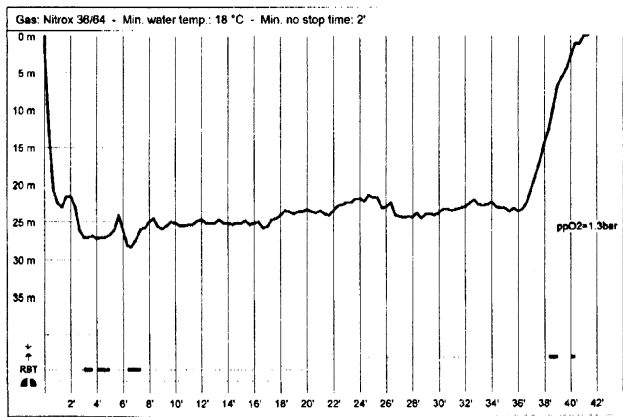
**Figure 1.** The printout from the dive computer used for a decompression air dive, for 38 minutes, that reached a maximum depth of 30.4 m. There was a 12 minute decompression period at around 5 m.

The black bars across the bottom of the graph at the level of the upward pointing arrow are records of the time that the rapid ascent alarm was activated. The black bar on the right, at the level of the down pointing arrow, shows when the alarm that decompression time still remained was activated.

### DIVING INCIDENTS ZONE 1

There was one case of oxygen toxicity using nitrox. A diver using nitrox 38% O<sub>2</sub> (PO<sub>2</sub> 0.38 bar at surface) was swimming at 22 m (PO<sub>2</sub> 1.21 bar), then dived down to 27 m (PO<sub>2</sub> 1.4 bar) against the current. Suddenly he experienced tunnel vision and became disorientated. He inflated the parachute used to raise the catch and rode up with it. Tunnel vision persisted for a while on board the boat. He now sets the computer alarm at 1.3 bar.

No DCS patients have reported recently for treatment. Musculoskeletal DCS in divers with more than 10 years experience is often self-treated with in-water recompression to the depth of relief then decompression empirically.



**Figure 2.** The printout from the dive computer used for a dive using nitrox (36% O<sub>2</sub>) to a maximum of 28.2 m (PO<sub>2</sub> 1.37 bar) which lasted for 39 minutes. The intended PO<sub>2</sub> for the dive was 1.3 bar.

The black bars on the left at the level of the letters RBT is when the exceeding planned depth alarm was activated. The black bars on the right, at the level of the upward pointing arrow, are records of the time that the rapid ascent alarm was activated.

There were no reports of DON, however there are a number of retired divers in the area who have shoulder pain.

### 1999 Overview Zone 2

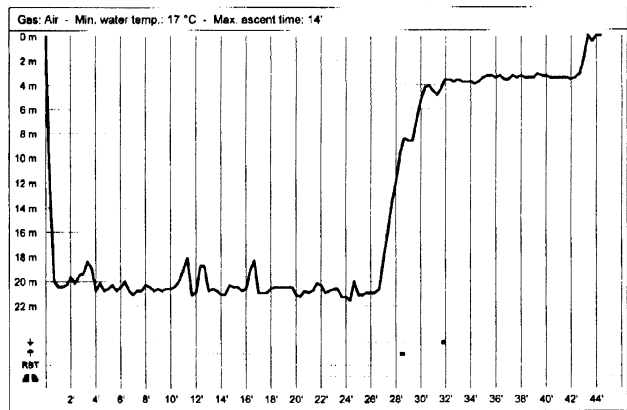
Of the eight divers working in Zone 2 four were between 25-32 years old and four were over 40. Most had recreational diver training, the others were self-taught and had on-the-job training. They used the same equipment as the Zone 1 divers. They used 7 or 9 mm wet suits with hot water from the engines. Summer water temperatures are 17°-23° C, going down to 15-20° C in winter.

Dives were usually in the 16-22 m range, however, some shells were collected at between 30-35 m. 20% of dives were deeper than 25 m.

They averaged about 60 diving days per year. Eight years ago they dived 125 days a year. The average dive time was between 3-4.5 hours a day. Bottom time varied depending on depth, but usually between 20-50 minutes (on average 35-40 minutes). Surface intervals average between 35-40 minutes. They commonly used dive computers, based on Bühlmann's tables. The average ascent rate was about 6 m/minute. Oxygen was used for decompression at 6 and 3 m, also at the surface, particularly on a rough day.

### DIVING INCIDENTS ZONE 2

There were two deaths. One followed a shark attack in 1998 and one diver died in 1999 from entrapment and running out of air.



**Figure 3.** The printout from the dive computer used for a decompression air dive lasting 42 minutes that reached a maximum depth of 21.6 m. There was a 10 minute decompression period at around 3 m.

The black bar at the bottom of the graph, at the level of the upward pointing arrow, records the time that the rapid ascent alarm was activated. The black bar on the right, at the level of the down pointing arrow, shows when the alarm that decompression time still remained was activated.

No DCS has been reported in the past 5 years, but it was as high as 20% in the past, mainly "niggles", rashes or itches. Neurological DCS was uncommon.

There was one known case of DON in the past. No accurate information about other cases was available.

### 1999 Overview Zone 3

This Zone is shallow, intertidal water. Diving is in depths up to 6 m with major problems with swells and surge. One third of the quota comes from around the Perth metropolitan area.

The 12 divers were aged between 20 and 50. They wore 13.6 kg (30 lb) weight belts and a 11.4 kg (25 lb) chest weight and walked on the bottom wearing rubber mining boots. They used neck bags which can hold 50 kg of abalone shells.

They dived for about 80-90 days a year, diving for 6-8 hours with bottom times of 2-3 hours and surface intervals of approximately 10-15 minutes.

No incidents of DCS were reported in 1999.

### Conclusions

It is claimed that over the past 5 years, there have been no cases of DCS despite the abalone divers' repetitive dives. Reverse dive profiles occurred in about 25% of the dives. The true incidence of DCS and DON is not known,

as currently there is no requirement for abalone divers to undergo commercial diving medical examinations.

There were 2 fatalities, one from entrapment (1999) and the other from shark attack (1998).

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## THE WORLD AS IT IS

### ASEPTIC BONE NECROSIS AS A DIAGNOSTIC PUZZLE

Robert M Wong and David Wright

#### Key Words

Legal and insurance, medical conditions and problems, osteonecrosis.

#### Introduction

Aseptic Bone Necrosis (ABN) is also known as Avascular Necrosis (AVN) and, when it occurs in divers and compressed air (caisson and tunnel) workers, as Dysbaric Osteonecrosis (DON).

Apart from hyperbaric exposure, there are many non-dysbaric causes. A number of non-dysbaric causative factors have been listed in text-books, some of these are, in alphabetical order:

- Alcaptonuria
- Alcoholism
- Arteriosclerosis
- Cirrhosis of the liver
- Diabetes mellitus
- Gaucher's disease
- Gout
- Haemoglobinopathies
- Hepatitis,
- Hyperlipidaemia
- Idiopathic
- Inflammatory bowel disease
- Organ transplant recipients
- Pancreatitis
- Rheumatoid arthritis
- Radiation
- Systemic Lupus Erythematosus

Radiological and pathological features of both dysbaric and non-dysbaric osteonecrosis are indistinguishable and both are characterised by intramedullary venous stasis, ischaemia and bone necrosis.

#### Occurrence in divers

The prevalence of DON has been reported to be as high as 79% in Greek professional divers,<sup>1</sup> 85.7% in Turkish sponge divers,<sup>2</sup> 65% in the Hawaiian diving fishermen,<sup>3</sup> while other diving fishermen in Japan also recorded in excess of 50%.<sup>4</sup> Australian abalone divers had a prevalence of 32%.<sup>5</sup>

Of course, these reports were about divers who often ignored normal decompression procedures, overstayed their bottom time and had inadequate decompression.

For divers who adhere to decompression tables, however, the incidence is much lower. Royal Navy Clearance divers had an incidence of about 5-7%.<sup>6</sup> Commercial divers had a 4.2% incidence.<sup>7</sup> Although it is very rare in recreational divers, nonetheless, DON has been described.<sup>8,9</sup>

#### Non-dysbaric ABN

Excluding hyperbaric exposure, trauma is a common cause of ABN. It has been stated that up to 30% of patients with certain medical conditions such as Systemic Lupus Erythematosus, Sickle Cell Anaemia, etc. may develop avascular necrosis.<sup>10</sup> In non-traumatic osteonecrosis, about two thirds of the cases are related to hypercortisonism and/or increased alcohol intake.<sup>10</sup>

ABN is the underlying diagnosis in 5% to 18% of the more than 500,000 total hip arthroplasties performed for advanced stages of osteoarthritis in the US and Western Europe.

#### A diagnostic problem

A man with osteoarthritis of his left hip was diagnosed as having AVN. A number of aetiological factors had to be entertained. Whatever the cause of his condition, it presented a dilemma to his Workers Compensation as he could no longer continue to work in his job.

## The history

A 37 year old married man (OA), a non-drinker with 3 children, had been employed for 14 years as a "pumper" in a colliery. His duties involved de-watering areas of the pit, with some heavy work, such as moving pumps, laying hoses and pulling pipes which reputedly could weigh up to 150 kg. Occasionally, he was required to drive machinery.

His initial problem, in May 1995, was low back pain radiating to the buttock areas for which he attended a chiropractor. He obtained relief from this treatment and continued to work without much difficulty.

In June 1996, OA reported a slow and progressive onset of pain over his left thigh and groin. By November 1996, he complained of increasing pain and discomfort in his left hip region such that he had difficulty lying on his left side at night. This time the chiropractor was unable to provide any relief. He claimed that he had been limping for some 3 months before this visit to the chiropractor.

Eventually, OA attended his GP and was prescribed anti-inflammatory medication, which provided significant relief. Nonetheless the pain persisted and he also noted morning stiffness of his left hip. The discomfort was such that he even tried acupuncture therapy for relief. On 16 December 1996, OA had an X-ray of his hips. This showed advanced osteoarthritis of both hips, the left hip being worse than the right.

He had no significant past history. His only injury had been to his lower back, while lifting a water container some years earlier, which kept him off work for 2 weeks. He had no problems in his hips as a child or as a teenager, nor had he suffered any traumatic injury.

After the diagnosis of osteoarthritis was made he was referred to an orthopaedic surgeon, whose examination confirmed moderate osteoarthritis of both hips, the left being worse than the right. Since osteoarthritis is quite unusual in men in their 30s, the orthopaedic surgeon was of the opinion that his heavy work over the years had contributed significantly to the onset of the symptoms.

As OA was unable to perform the task for which he was employed and with this orthopaedic opinion, his problem became a Workers' Compensation case. Whether his work has caused or contributed significantly to the onset of his arthritic symptoms became a major issue.

The company's Occupational Physician was of the opinion that OA's work was most unlikely to be a contributing factor. The Occupational Physician, if it was thought that the osteoarthritis was work related, was interested in investigating all the other workers doing the same work to see what proportion of them had developed arthritis.

The employer informed the Occupational Physician that OA has been known to use a petrol driven compressor in a boat for a surface supply (hookah), for "prolonged periods" (up to 3-4 hours at a time), to catch crayfish. It was also stated that one of OA's friends was being prosecuted by the Fisheries Department for illegal fishing (this was all hearsay and not documented). The implication was that OA must have been a party to this illegal fishing and must have done substantial diving.

On the basis of this information, the Occupational Physician decided that OA's osteoarthritis was most likely to be due to diving.

Eventually, the employer decided to seek another opinion and asked RMW to review OA about the likelihood of him having developed his condition from diving.

The history OA gave me was that outlined above. He claimed that he had suffered from neck and lower backache in May 1995, for which he saw a chiropractor as well as a medical practitioner.

When RMW reviewed him, OA stated that his condition had remained static. He mentioned that cortisone injection given by his local medical practitioner did help to ease the pain and that he could sleep reasonably well at night.

OA did not deny that he had dived but his story differed from the employer's story. He had been doing breath-hold diving since he was 12 years old. About 1992, some 6 years before I saw him, he was taught to "hookah" dive by friends. He never formally learned to dive nor had a diving medical. He was not a regular compressed air diver, diving only during Christmas holidays with his friends to get a few crayfish, abalone and fish. He might make 3 or 4 dive trips during the holiday season. The dive profile he claimed would be to a depth of 6 m (20 ft) with a bottom time of no more than 30 minutes. Sometimes, he would dive 2 or 3 times in a day, with a surface interval of 1 to 2 hours. He had not done any commercial diving nor engaged in multi-day diving. He denied having any incidents of DCS or prolonged diving. When saw OA he had not dived for two years.

On 9 September 1997 OA had another radiological examination and a MRI of his hip. The radiological report stated that "this patient has developed Avascular Necrosis of the femoral head on the left side. When comparing this area with the previous film in 1996 there is no doubt that there was a bony abnormality at this stage. On the previous study no evidence of old Perthe's or slipped femoral epiphysis or deformity of the articular surface but there has been progression and characteristic development of avascular necrosis, with structural failure, and focal areas of ischaemia and bony regeneration and repair...". The radiologist was confident of the diagnosis of avascular necrosis and advised that a MRI would not be necessary.



**Discussion**

OA's history and findings leave the cause of his ABN up in the air. Could his ABN be the result of other conditions apart from trauma, or hyperbaric exposure? There are at least four questions that need an answer.

- 1 What is the likely cause of ABN in this patient?
- 2 Was it a work related consequence of dragging heavy weights around for a protracted period (years) in a man in his 30s?
- 3 Was it due to his diving activity?
- 4 Was it due to one of the many medical conditions that could give rise to ABN?

He did not have a history of trauma. Although admitted to being a "diver", his hyperbaric exposures would not be considered as likely to be the causative factor. He has never suffered decompression sickness at any stage. He is a non-drinker and not on any medications (the cortisone injections he received for pain relief after the diagnosis would hardly be responsible).

To exclude the non-traumatic conditions, a series of laboratory investigations were done, and the results are shown in Table 1. The asterisks \* indicate abnormal results.

Reviewing OA's history and various investigations the abnormal results were that his lipids, cholesterol, triglycerides and apolipoprotein were elevated.

**TABLE 1**

(\* is an abnormal result)

**Haemoglobin studies**

	Result	Normal range
Hb A2	2.6%	(1.5-3.5%)
Hb F	0.6%	(0.1-1.0%)
Hb H inclusions	negative	
Unstable HB	negative	
Qualitative Hb electrophoresis - electrophoretic mobility as Hb A/A		

**Biochemistry studies**

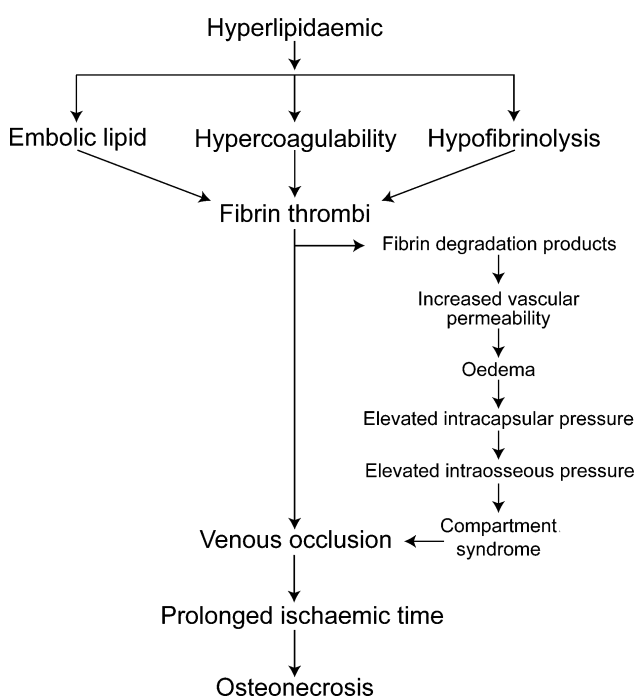
Cholesterol	6.2*	(<5.5 mmol/l)
Triglycerides	4.6*	(<2.0 mmol/l)
HDL cholesterol	1.20	(>1.0 mmol/l)
LDL cholesterol		(cannot be calculated when triglycerides are 4.5 mmol or greater)
Alpha fetoprotein	4	(<11 ku/l)
Apolipoprotein B	1.17*	(<1.00 g/l)
Lipoprotein a	0.1	(<0.3 g/l)
Blood glucose	5.3	(3.9-6.2 mmol/l)
Bilirubin	5	(3-20 umol/l)
Alkaline phosphatase	108	(35-135 u/l)
Alanine aminotransferase	29	(0-40 u/l)
Gamma glutamyl transferase	60	(10-65 u/l)
Albumin	45	(35-50 g/l)
Uric acid	0.30	(0.20-0.42 mmol/l)

**Urine**

24 hour creatinine	21.6*	(7.0-18.0 mmol/d)
24 hour urate	5.3	(<6.1 mmol/d)
24 hour urine volume	1.47 l	

**FIGURE 1**

**MECHANISMS LEADING TO ISCHAEMIC NECROSIS OF BONE**



It is known that Type II and IV Hyperlipidaemia predispose to AVN.<sup>11</sup> Jones has proposed that AVN could result from vascular stasis, hypercoagulability, endothelial damage (by free fatty acids) and intravascular coagulation.<sup>12</sup> Hyperlipidaemia has been linked to hypercoagulability and hyperfibrinolysis, which are further associated with a tendency to venous thrombosis.<sup>13</sup> It has also been proposed that osteoarthritis and AVN could result from obstruction of susceptible joint microvasculature by embolic lipid and thrombi.<sup>14</sup>

Fig 1 shows the proposed mechanism leading to ischaemic necrosis of bone (modified from Cheras).<sup>14</sup>

The pathways show how lipid abnormalities could promote fibrin thrombi, leading to occlusion of susceptible joint microvasculature. Increased vascular permeability subsequent to thrombolysis leads to elevated intracapsular pressure (ICP) and intraosseous pressure (IOP), establishing

a compartment syndrome and further compounding venous occlusion.

In OA's case the first X-ray (December 1996) was reported as showing only osteoarthritis. Nine months later he was diagnosed as AVN. The 1997 report, quoted above, can be read as suggesting that there was a bony abnormality in the 1996 film, but the words "at this stage" do not clearly refer to 1996. In any case there was generalised osteoarthritis of both hips on the 1996 X-rays.

Was the osteoarthritis due to years of lugging heavy weight around? Was it due to diving? These factors were considered unlikely to be responsible for his AVN.

Or was it, assuming the above scenario, that OA's AVN was due to hyperlipidaemia? This was considered likely. Could all these factors be synergistic in producing his condition? From the evidence it is hard to tell.

If the reader was referred such a case, what advice should be offered to the compensation tribunal? Also how would one expect the court to settle such a Workers Compensation claim?

To find out what happened in this case turn the page upside down.

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*Dr David A Wright, FRACGP, is a Registrar in the Department.*

The worker was not happy about the medical report, that it could be his constitutional problems and went to his union. The discussion that ensued convinced the worker and the Union representative that the settlement offered by the employing company was reasonable, especially as the company lawyer pushed the issue of his diving using hookah. The only person who suggested that it was work related was the orthopaedic surgeon. Finally, he conceded that his ABN was not work related, took the money and left his employment. We have no further information about this man.

**Months later**

## SPUMS NOTICES

### SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

#### DIPLOMA OF DIVING AND HYPERBARIC MEDICINE

##### Requirements for candidates

In order for the Diploma of Diving and Hyperbaric Medicine to be awarded by the society, the candidate must comply with the following conditions:

- 1 The candidate must be a financial member of the Society.
- 2 The candidate must supply evidence of satisfactory completion of examined courses in both Basic and Advanced Course in Diving and Hyperbaric Medicine at an approved institution.
- 3 The candidate must have completed the equivalent (as determined by the Education Officer) of at least six months full time training in an approved Hyperbaric Medicine Unit.
- 4 The candidate must submit a written research proposal in a standard format for approval by the Education Officer before commencing their research project.
- 5 The candidate must produce, to the satisfaction of the Education Officer, a written report on the approved research project, in the form of a scientific paper suitable for publication.

##### Additional information

The candidate must contact the Education Officer to advise of their intended candidacy, seek approval of their courses in Diving and Hyperbaric Medicine and training time in the intended Hyperbaric Medicine Unit, discuss the proposed subject matter of their research proposed, and obtain instructions before submitting any written material or commencing a research project.

All research reports must clearly test a hypothesis. Preference will be given to reports of original basic or clinical research. Case series reports may be acceptable if thoroughly documented, subject to quantitative analysis, and the subject is extensively researched and discussed in detail. Reports of a single case are insufficient. Review articles may be acceptable if the world literature is thoroughly analysed and discussed, and the subject has not recently been similarly reviewed. Previously published material will not be considered.

It is expected that all research will be conducted in accordance with the "Joint NH&MRC/AVCC statement and guidelines on research practice" (available at <http://www.health.gov.au/nhmrc/research/nhmrcavc.htm>). All research involving humans or animals must be accompanied by documentary evidence of approval by an appropriate research ethics committee. It is expected that research project and the written report will be primarily the work of the candidate.

The Education Officer reserves the right to modify any of these requirements from time to time.

The Education Officer's address is Dr David Doolette, Department of Anaesthesia and Intensive Care, The University of Adelaide, Adelaide, South Australia 5005. Telephone +61-(0)8-8303-6382. Fax +61-(0)8-8303-3909. E-mail <David.Doolette@adelaide.edu.au>.

##### Key Words

Qualifications.

### FINANCIAL REPORTS

The audited financial reports for 1998 and 1999 have never been published. At the 2001 AGM at Madang the audited financial reports for 1998, 1999 and 2000 were presented. The audited financial reports for 1998 and 1999 with the minutes of the 2000 Annual General Meeting appear in this issue.

### AUDIT REPORT TO THE MEMBERS OF THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

I have conducted various tests and checks as I believe are necessary considering the size and nature of the Society and having so examined the books and records of The South Pacific Underwater Medicine Society for the year ended 31 December 1998 report that the accompanying Statement of Receipts and Payments has been properly drawn up from the records of the Society and gives a true and fair view of the financial activities for the year then ended.

Dated 2001/5/25  
Level 3, Suite 304  
20 Bungan Road  
Mona Vale, New South Wales 2103

David S Porter  
Chartered Accountant

**THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY  
STATEMENT OF RECEIPTS AND PAYMENTS  
FOR THE YEAR ENDED 31 DECEMBER 1998**

	<b>1998</b>	<b>1997</b>
<b>OPENING BALANCE</b>		
ANZ bank		
1998 ASM account	1,740	
Access Cheque account	33,170	32,041
ANZ V2 PLUS	<u>80,000</u>	<u>68,045</u>
	<u>114,910</u>	<u>100,086</u>
<b>RECEIPTS</b>		
Subscriptions and Registrations	133,390	92,518
Interest	3,931	4,388
Advertising and Journal sales	280	402
Sundry Income	-	210
	<u>137,601</u>	<u>97,518</u>
	<u>252,511</u>	<u>197,604</u>
<b>PAYMENTS</b>		
ASM costs	51,701	6,161
Secretarial	8,662	4,754
Stationery and Printing	2,790	1,198
Journal	33,004	27,554
Postage and Facsimile	2,817	4,459
Conferences and Telephone	9,860	6,952
Computer Equipment	8,331	8,281
Miscellaneous/Subscriptions	2,385	2,223
Bank Charges	3,084	2,151
Audit	1,320	1,100
Editors honorarium	15,600	15,300
Oxydive kit	-	2,561
	<u>139,554</u>	<u>82,694</u>
<b>CLOSING BALANCES</b>		
ANZ bank		
1998 ASM Account	11,984	1,740
Access Cheque Account	25,973	33,170
ANZ PLUS	<u>75,000</u>	<u>80,000</u>
	<u>\$ 112,957</u>	<u>\$ 114,910</u>

These are the accounts referred to in the report of D S Porter, Chartered Accountant, Mona Vale, NSW 2103.  
Dated 2001/5/25

**SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY  
COMMITTEE REPORT  
FOR THE YEAR ENDED 31 DECEMBER 1998**

The Committee of the Society states that:-

The accounts annexed hereto present fairly the result of the operations of the Society for the financial year ended 31 December 1998 and the state of affairs of the Society as at the end of the financial year ended on 31 December 1998.

The committee has reasonable grounds to believe that the Society will be able to pay its debts as and when they fall due.

There is no body corporate that is a subsidiary of the Society.

The Society is not trustee of any Trust.

SIGNED for and on behalf of the Committee in accordance with a resolution of the Committee made on the 29th day of May 2001.

Robyn Walker, President, Catherine Meehan, Secretary

## MINUTES OF THE ANNUAL GENERAL MEETING OF SPUMS

held on Castaway Island, Fiji, 2000/5/13  
at 1700 local time.

Editor	Dr John Knight
Public Officer	Dr Guy Williams
Education Officer	Dr David Griffiths (resigned)
Committee Members	Dr Chris Acott
	Dr Simon Mitchell
	Dr Douglas Walker

### Present

All members attending the Annual Scientific Meeting.

### Apologies

Dr David Griffith.

### 1 Minutes of the previous Meeting

Minutes of the previous meeting have been published (SPUMS J 2000; 30 (1): 13-15).

Motion that the minutes be taken as read and is an accurate record. Proposed Dr John Knight, seconded Dr Vanessa Haller. Carried.

### 2 Matters arising from the minutes

None.

### 3 President's Report

Printed on page 143.

### 4 Secretary's Report

Not available at the time of printing.

### 5 Annual Financial Statement and Treasurer's Report

These were not available.

### 6 Subscription fees for the forthcoming year

In the absence of the Treasurer, Dr Peter Dupont, the Committee recommended an increase in membership fees.

Motion that SPUMS membership fees for members be \$110.00 (\$121.00 including GST or mailing charge for members outside Australia) and for associates \$55.00 (\$65.00 including GST or mailing charge for associates outside Australia). Proposed Dr John Knight, seconded Dr Simon Mitchell. Carried.

### 7 Election of office bearers

Due to the resignation of the Education Officer, this position is vacant. All other positions are filled for a further two years.

President	Dr Robyn Walker
Secretary	Dr Cathy Meehan
Treasurer	Dr Peter Dupont

### 8 Appointment of the Auditor

No information was available from the Treasurer.

### 9 Business of which notice has been given

9.1 Motion that Terry Cummins be elected to full membership for his contributions to diving safety. Proposed Dr Des Gorman seconded Dr Mike Davis. Carried.

9.2 Motion that David Doolette be elected to full membership for his contribution to diving safety. Proposed Dr Des Gorman, seconded Dr Mike Davis. Carried.

#### 9.3 Motions proposing alterations to the SPUMS Statement of Purposes and Rules

9.3.1 That the heading Board of Censors on page 19 of the Statement of Purposes and Rules be changed to *Academic Board*.

9.3.2 That Rule 42 be changed by replacing the existing wording with *The Committee will appoint an Academic Board headed by the Education Officer*.

9.3.3 That Rule 42 (a) be changed by replacing the existing wording with *The make up of this Board will comprise individuals with proven clinical, scientific and research skills in the fields of diving and hyperbaric medicine. The minimum number of Board Members will be the Education Officer and two others*.

9.3.4 That Rules 42 (b) and 42 (c) be amended by removing the words of *Censors* from both rules.

Proposed Dr Robyn Walker, seconded Dr Des Gorman. Carried.

These amendments will not come into effect until approved by the general body of members.

This proposal will be printed in the June 2000 Journal.

If no member objects to this proposal, in writing, to the Secretary by 2000/9/1 it will be assumed that the Society has voted to approve the change to the constitution.

Meeting closed at 1730.

### Key Words

Constitutional amendments, meeting.

**THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY  
STATEMENT OF RECEIPTS AND PAYMENTS  
FOR THE YEAR ENDED 31 DECEMBER 1999**

	<b>1999</b>	<b>1998</b>
<b>OPENING BALANCE</b>		
ANZ bank		
1998 ASM account	11,984	1,740
Access Cheque account	25,973	33,170
ANZ V2 PLUS	<u>75,000</u>	<u>80,000</u>
	<u>112,957</u>	<u>114,910</u>
<b>RECEIPTS</b>		
Subscriptions and Registrations	138,338	133,390
Interest	3,362	3,931
Advertising and Journal sales	90	280
Sundry Income	<u>3</u>	<u>-</u>
	<u>141,793</u>	<u>137,601</u>
	<u>254,750</u>	<u>252,511</u>
<b>PAYMENTS</b>		
ASM costs	44,116	51,701
Bank adjustment	1,271	-
Uncategorised expenses	3,957	-
Secretarial	11,468	8,662
Stationery and Printing	3,220	2,790
Journal	28,432	33,004
Postage and Facsimile	5,896	2,817
Conferences and Telephone	10,450	9,860
Computer Equipment	25,553	8,331
Miscellaneous/Subscriptions	1,818	2,385
Bank Charges	2,610	3,084
Audit	-	1,320
ASM deposit	4,058	-
Editor's honorarium	15,602	15,600
Audio-Video Equipment	11,305	-
Insurance	<u>3,287</u>	<u>-</u>
	<u>173,043</u>	<u>139,554</u>
<b>CLOSING BALANCES</b>		
ANZ bank		
1998 ASM Account	612	11,984
Access Cheque Account	3,119	25,973
ANZ V2 PLUS	<u>77,976</u>	<u>75,000</u>
	<u>\$ 81,707</u>	<u>\$ 112,957</u>

These are the accounts referred to in the report of D S Porter, Chartered Accountant, Mona Vale, NSW 2103. Dated 2001/5/25

**AUDIT REPORT  
TO THE MEMBERS OF THE SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY**

I have conducted various tests and checks as I believe are necessary considering the size and nature of the Society and having so examined the books and records of The South Pacific Underwater Medicine Society for the year ended 31 December 1999 report that the accompanying Statement of Receipts and Payments has been properly drawn up from the records of the Society and gives a true and fair view of the financial activities for the year then ended.

Dated 2001/5/25  
Level 3, Suite 304, 20 Bungan Road, Mona Vale, New South Wales 2103

David S Porter  
Chartered Accountant

**SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY  
COMMITTEE REPORT  
FOR THE YEAR ENDED 31 DECEMBER 1999**

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The committee has reasonable grounds to believe that the Society will be able to pay its debts as and when they fall due.

There is no body corporate that is a subsidiary of the Society.

The Society is not trustee of any Trust.

SIGNED for and on behalf of the Committee in accordance with a resolution of the Committee made on the 29th day of May 2001.

Robyn Walker, President, Catherine Meehan, Secretary

**THE PRESIDENT'S REPORT 2000**

It is 12 months since I was elected to the position of President of this Society. I believe it is important to maintain the founding principles of the Society but also to advance and change as the environment in which we operate changes.

Although for most of you the rules by which the Society operates are not a major concern, your elected committee must deal with issues within the framework of our Constitution. I believe it is important to maintain the diving heritage and leave the field of hyperbaric medicine to our colleagues in the Australian and New Zealand Hyperbaric Medicine Group (albeit a sub-committee of SPUMS). There is however a proposal to formalise the training for diving and hyperbaric medicine physicians by the College of Anaesthetists. I believe it is important that SPUMS continues to be heard as a voice on diving medicine and we will liaise closely with the College of Anaesthetists Special Interest Group in Diving and Hyperbaric Medicine to protect our Society's role. It is also important to acknowledge that training and education can only further the Society's role to promote and facilitate the study of all aspects of underwater and hyperbaric medicine.

This year we have sadly seen the resignation of David Griffiths as Education Officer. All positions on the Committee (other than Editor) receive no remuneration for the often extensive time involvement that accompanies these roles. David has been unable to devote the time he thought necessary to perform the role of Education Officer, to the standard he believes it deserves, and has subsequently resigned. I apologise to those candidates who have experienced difficulty in obtaining approval for their Diploma submissions. I also assure you we have spent many hours trying to improve upon the current system and these proposals will be presented later in this meeting as a constitutional change. It is vital, particularly with the creation of the Special Interest Group in Diving and

Hyperbaric Medicine that the SPUMS Diploma remains relevant, achievable and clearly defined.

During the year John Knight has expended considerable energy in striving to have the SPUMS Journal indexed. Non-indexed journals find it difficult to attract high quality papers and publishing in such journals is certainly not encouraged by many tertiary educational institutions. This limits the quality of the manuscripts received. We are continuing down this pathway and in the near future you can expect a name change to the journal, from the SPUMS Journal to the South Pacific Underwater Medicine Society Journal. Although a minor change it is believed necessary in furthering our attempts to have the journal recognised by indexing agencies.

I would like to thank the Committee members for all their efforts during the year. Behind the scenes work impinges on valued free hours and is hard at times to explain/justify to our families. Thank you.

Once again the annual scientific meeting has been highly successful, generating extensive debate and hopefully encouraging us all to continue to question our traditional beliefs and search for the data that is becoming so essential in the times of evidence-based medicine.

The Society is, I believe, the only organisation, which focuses on the needs of the diver, particularly the recreational diver, and we should be proud of its achievements.

Next year in Madang this achievement will again be pursued. The topic of the meeting is the Lung and Diving with a workshop on Near Drowning and I encourage you all to attend.

Robyn Walker

**Key Words**  
Meeting.

**SPUMS 2002 ASM**

to be held at

**Iririki Island Resort, Port Vila, Vanuatu**Friday May 17th to Friday May 24th  
(barring airline scheduling changes)**THEMES****Diving and travelling in remote localities  
Morbidity and mortality associated with diving  
equipment**Members wishing to present papers should contact  
CMDR Robyn WalkerDeputy Fleet Medical Officer, Maritime Headquarters  
1 Wylde St, Potts Point, New South Wales 2011, Australia  
Phone + 61-02-9359-4563. Fax + 61-02-9359-4554  
E-mail <Robyn.Walker@defence.gov.au>**Deadline for abstract submission is 24 February 2002**The Official Travel Agent is  
Allways Dive Expeditions  
168 High Street  
Ashburton, Victoria 3147, Australia  
Tel + 61-(0)3-9885-8863  
Toll Free 1800-338-239  
Fax + 61-(0)3-9885-1164  
E-mail <allwaysdive@atlasmail.com>**ALL SPUMS JOURNALS 1971 TO 2000****NOW AVAILABLE ON CD**

The South Pacific Underwater Medicine Society has produced a CD, readable by at least Windows and Macintosh computers, containing every issue of the Society's Newsletter and Journals as Adobe .pdf documents, from the first issue in May 1971 until, and including, December 2000. All that is needed to read and print these documents is Adobe Acrobat Reader (version 3 or later) which can be downloaded free from the Adobe web site.

The CD also contains the index for the South Pacific Underwater Medicine Society Journal from 1971 (Volume 1) to December 2000 (Volume 30 No. 4). The index is supplied as a downloadable tab-separated document which can be entered into the reader's database. It is supplied in RTF (rich text format) and as Windows 97 DOC and TXT for Windows. Macintosh formats are RTF and Word for Mac 5.1.

The CD is available from the Editor or the Administrator of SPUMS, C/o ANZ College of Anaesthetists, 630 St Kilda Road, Melbourne, Victoria 3004, Australia, for \$Aust 25 (including GST or overseas mailing charge).

*Needed***An Editor for the SPUMS Journal.**

The term of Dr John Knight as Editor of the South Pacific Underwater Medicine Society Journal expires at the 2002 Annual General Meeting.

He has informed the Committee that he will not be available for reappointment. However he is willing to produce the June 2002 issue of the Journal.

The Journal exists to provide education in underwater and hyperbaric medicine to the membership, which is about one third non-medical associate members. The Journal is the only way we have to make the Annual Scientific Meeting available to the 90% of the membership which cannot attend the meeting.

The Editor is responsible for the production, printing and distribution of the South Pacific Underwater Medicine Society Journal. A part of the production of the Journal is providing an annual update of the cumulative index, published with the December issue each year. Maintaining the index, which is now available on CD with Adobe .pdf documents of all the issue of the Journal from 1971 to December 2000.

The Editor of the South Pacific Underwater Medicine Society Journal is an appointed position and there is an honorarium.

Selected applicants will be invited to submit a proposal to the SPUMS Executive Committee outlining how they intend to deliver the Journal. Remuneration will be dependent upon the level of individual involvement and the level of professional services utilised in the production of the Journal. Recommended reading is The Australian Editing Handbook (\$ 44.00).

The Editor has a part to play in running the Society as he (or she) has a place on the Executive Committee. The appointment is for three years.

Members interested in taking the position of Editor should apply in writing to  
Dr Cathy Meehan, Secretary of SPUMS  
C/o ANZ College of Anaesthetists  
630 St Kilda Road  
Melbourne, Victoria 3004  
Australia  
or by e-mail <cmeehan@ozemail.com.au>  
for details of the duties of the Editor. They should nominate their requirements for accepting the position and the date at which they would be able to commence duties.



**WORLD CONGRESS OF DROWNING, 2002**

To be held in Amsterdam  
on 26, 27 and 28 June 2002

**Breath-hold, scuba and hose diving**

Recreational scuba diving is recognised as a safe sporting activity. There are relatively few accidents compared with other sports although, when an accident does occur in the water, it happens in a very unforgiving environment. What might be an insignificant incident at the surface can start a sequence of events that quickly escalates to become life threatening. The environment in which this happens is also the probable reason why up to some 60 per cent of in-water diving fatalities meet their deaths by drowning. Drowning is the *mode* of their deaths, but not the cause. In examining the *causes* of drowning in divers, one must look at the way in which people dive. To reduce the risk of drowning in divers one must address not only their in-water procedures but also basic issues such as fitness, training and equipment.

For this reason the diving community has been invited to participate in the **World Congress of Drowning** to be held in Amsterdam on 26, 27 and 28 June 2002. This conference was initiated by *The Society to Rescue Persons from Drowning* which was founded in the Netherlands in 1767.

Partners in this venture include the International Federation of Red Cross and Red Crescent, ILS (International Life Saving) and DAN.

**The aims of the Congress are**

to make recommendations on the prevention, rescue and treatment of drowning victims;  
to stimulate and facilitate initiatives to further promote the prevention of drowning;  
to reduce the number of drowning victims;  
to improve the survival rate and outcome of drowning victims.

**“Breath-hold, scuba and hose diving”** (Chairman: David Elliott, UK) is thus just one of around 10 task forces convened to review particular aspects of this vast topic.

Other task forces and Chairpersons include

Epidemiology	Christine Branche, CDC, Atlanta.
Rescue	Chris Brewster, International Life Saving Federation, USA.
Resuscitation	Paul Pepe, Emergency Medicine, University of Texas.
Hospital treatment	Jean Louis Vincent, Erasmus Hospital, Brussels.
Immersion hypothermia	Beat Walpoth, University Hospital, Insel, Switzerland
Brain	David Warner, Duke University Medical Center, USA.

Each task force has an international group of experts in the appropriate specialities.

The diving task force covers the hazards associated with all types of diving. This includes recreational diving of every variety. It also covers subsistence fishermen-divers in the third world, most of whom have inadequate equipment and no proper training and who have an unknown rate of in-water incidents. The other large group is military and working divers who follow procedures that for them should make the risk of drowning negligible.

A number of drowning fatalities in divers occurs among divers who may have made an avoidable error or who may have been subjected to one. After reviewing such accidents the task force has prepared draft recommendations and reviewed those submitted by others. The following topics are among the questions that they consider deserve discussion at the World Congress.

Should diver certification last a lifetime, or is there a need for re-certification after a few years?

What changes can be recommended in the training of divers and diving instructors that might enhance diving safety?

Should a once-only medical declaration that was made before training potentially last for a lifetime?

Is there a minimum age for diving as one of a buddy-pair?

Should there be a greater emphasis at all levels of recreational diver training on the causation of known in-water fatalities?

Visit the web site ([www.drowning.nl](http://www.drowning.nl)) for more details about the Congress, its task forces and the arrangements. Some 60 task force members from 20 nations have prepared formal presentations and reviewed the many recommendations for the Congress. Each task force has a summary of its proposed agenda, each will have a plenary session for all and then a number of sessions on selected diving topics.

Look through the recommendations in the diving section. Because they come from a wide range of sources, some appear worthwhile but others may not be universally acceptable. These will be discussed and, where appropriate, their implementation will be reviewed at the Congress in Amsterdam, 2002.

You can also write for more information to the World Congress of Diving 2002 Secretariat  
c/o Consumer Safety Institute  
PO Box 75169, 1070 AD Amsterdam, The Netherlands.  
or e-mail <[Secretariat@drowning.nl](mailto:Secretariat@drowning.nl)>

**Key Words**

Breathhold diving, drowning, meeting, occupational diving, recreational diving.

## LETTERS TO THE EDITOR

### NEW ZEALAND UNDERWATER INCIDENT AND ACCIDENT RECORDER

New Zealand Underwater  
PO Box 875  
Auckland  
New Zealand  
2001/7/6

Dear Editor

I wish to inform the members of the South Pacific Underwater Medicine Society that I am the new Underwater Incident and Accident Recorder for New Zealand Underwater. New Zealand Underwater is a not-for-profit organisation which encourages and promotes safe and enjoyable participation in our underwater environment. I, and most of the committee members, give time freely in support of the organisation.

I welcome any suggestions from SPUMS members on what pro-active data would be valuable to try and start collecting from New Zealand divers, how we can best work together to share our information and collaborate where appropriate. I also intend to liaise closely with the hyperbaric oxygen units in New Zealand, Divers Alert Network, the British Sub-Aqua Club and the diver training agencies.

I will be pleased to provide the Journal with regular updates when appropriate and look forward to presenting a review of the relevant New Zealand data at the SPUMS 2002 Annual Scientific Meeting in Port Vila.

Lynn Taylor, PhD  
<Ltt21040@gsk.com>

#### Key Words

Incidents, letter, research.

### OZTEK 2002 IN SYDNEY - CALL FOR PAPERS

PO Box 894, Willoughby  
New South Wales 2068  
Australia  
2001/6/18

Dear Editor

The Organisers for the OZTeK Australian Diving Technologies Conference and Rebreather Forum are pleased to announce that, following the demand from divers around Australia, dates have been set for the next OZTeK Conference, 20-22 September 2002 in Sydney. There will be an International Guest list of speakers that will attract

divers at all levels. OZTeK 2002 has already secured some great speakers and exciting presentations that will delve into areas not covered in the last two shows.

OZTeK2002 will be held at the Australian Technology Park near to the Central Railway Station and will focus on three main areas, Diving Technology in the 21st Century, Exploration and Women in Diving, all under the overall banner of "Extending the Limits in the 21st Century".

OZTeK is looking for Australian content and we are asking all Technical Divers, Hyperbaric Doctors and anyone in the region interested in presenting a Technically focused paper to contact us. OZTeK is about Australian Diving Technology, and as the 1999 and 2000 events showed, Australian and New Zealand are as active in equipment and scientific development and exploration as anywhere in the world. OZTeK2002 will be the diving event of 2002 to showcase these developments and all enquiries are welcome.

OZTeK has been very well supported in the past by local and international sponsors and attendees and many people have made themselves available as presenters. I would like to thank all those involved in OZTeK in the past and all who attended the last two shows will know what a sterling effort everyone put in to make OZTeK the success it was. Next year will be bigger and better than ever, and we intend to announce the first of our international speaker list very shortly.

Contact for OZTeK 2002 is Richard Taylor, on +61-0500-834-269, Fax: +61-(0)2-9958-3795, Mobile +61-0417-426-316 or by e-mail on <tdi\_aust@compuserve.com>.

Richard Taylor

#### Key Words

Letter, meeting, technical diving.

The



Home Page

which gives access to the  
**SPUMS Journal Index 1971-1998**

is at

<http://www.SPUMS.org.au>

## BOOK REVIEWS

### GOLDFINDER

Keith Jessop.

ISBN 0-684-82147-8. Published 1997.

Simon and Schuster, London.

Review copy purchased from Ocean Enterprises, Yarram, Victoria. Hard cover \$32.00. Postage and packing extra.

### SALVAGE OF THE CENTURY

Ric Wharton.

ISBN 0-941332-79-9. Published 2000.

Best Publishing Company, P.O.Box 30100, Flagstaff, Arizona 86003-0100, U.S.A.

Price from the publishers \$US 39.50. Postage and packing extra. Credit card orders may be placed by phone on +1-520-527-1055 or faxed to +1-520-526-0370. E-mail [divebooks@bestpub.com](mailto:divebooks@bestpub.com).

Two books have recently been published on the salvage of the gold from HMS EDINBURGH. There were two salvage trips, 1981 and 1986. It occurred to me that combining a review of the two books would be an interesting project. To avoid unnecessary repetition, I have first addressed the shared story of HMS EDINBURGH and the salvage, and then the different ways that the two authors have covered the same story.

Before leaving Murmansk to return to the UK after escorting a convoy to Russia in 1942, HMS EDINBURGH was loaded with four hundred and sixty five gold bars of Russian gold. En route an encounter with a German U Boat disabled the EDINBURGH. She was returning to Murmansk when a further attack by surface craft caused her to sink. 57 lives were lost in the encounter and all the gold went, with the ship, to the ocean floor.

Treasure searches seem to bring out the worst facets of human nature, and to some extent this is the story here, the attraction of great wealth and the risk to obtain that wealth. The location of the sinking has extreme weather problems similar to those faced by those who are salvaging the Russian submarine *Kursk* from waters close by.

Both books detail the search for financial support, which proved to be as great a problem as the search for HMS EDINBURGH. In some cases the partners of this joint venture showed varying degrees of greed, which was, predictably, inversely proportional to the closeness to or the accumulating, veritable pile of gold bars. A great perspective is offered into what can and did occur when the worlds of big business and of treasure hunters mixed. The characters of two of the main players, Wharton and Williams, as shown in the books should come as no surprise for any diver who worked for them at Comex or 2W back in "The Good Old Days" of the North Sea.

Finding a suitable vessel for first the survey/search and then the salvage for the first, "No Cure No Pay" trip was quite a problem. The new technology for diving at these extreme depths was just being developed in step with the EDINBURGH salvage. Dynamic positioning to allow the position to be kept without anchors and a suitable diving spread were rare items in 1980's. By the time of the second trip, 1986, 2W (Ric and M Williams dive company) had acquired two suitable vessels of their own, one of these *Deepwater 2*, a state of the art DSV (Diving Support Vessel), was used.

Ric Wharton in *Salvage of the Century*, and to some extent Keith Jessop, takes a swipe at the British Government, with, from the accounts, a fair degree of right on their side. The government departments, and their doubtful actions, draw the dry wit of Wharton when describing these events. Some media folk, lawyers and others were not exempt from this process either.

There is also the enduring mystery of the missing gold bars. The salvors mounted two expeditions to the wreck to recover the gold. On the second trip, none of the original diving crew returned. Only one was scheduled to return, but missed the sailing time by being detained by the Police, immediately before sailing, on very suspect, soon dismissed charges. On the first dive of the second trip, a camera mounted on the EDINBURGH was missing, as were several bars of gold set aside, waiting to be recovered. There is some great speculation but no real facts in this part of the story, but that all adds to the tale.

Gold, being heavy, was stored in the bomb room deep in the hull, to assist in ship stability, this also did not harm any security concerns. Reaching the bomb room required a very accurate hole to be cut through the hull down to this area. A sister ship, HMS BELFAST, now moored as a museum at London, provided much needed detail during the planning of the project.

Both books show commercial divers as hard working professionals. The books contain the inevitable tales that have embellished this professional divers image with the quite common myth of divers also being several parts pirate. The story of the "tricks" when describing how EDINBURGH's crests were obtained from the Admiral's Barge, against "official wishes" serves to perpetuate such myths.

Both books offer a great read, and have all the required ingredients for a good story, with the added attraction of being true. The two books allow direct comparison and they both remain true to the facts, but as with most things in life, where you are standing biases the

picture a bit. Wharton does have the added advantage of being the later publication.

The academic training of Ric Wharton (a civil engineer) shows in the great way that he details significant other historical salvage events. However the side stories add to the overall interest of the reader, they are well researched and enjoyable. Keith Jessop on the other hand provides some grand tales of how to make a living diving in the scrap business in Scotland.

Ric Wharton's book is larger format than Goldfinder and both are very well illustrated. Goldfinder is almost twice the number of pages, at 419, than *Salvage of the Century*. Ric deals in greater detail with the technical challenge of the saturation dives, amongst the deepest of the time at 244 metres (800 feet) and other related historical matters. Keith spends quite some time on his early diving work and seems more compelled to write about legal and other administrative matters, perhaps showing a need to set the "record" straight?

This quite different social background of both authors, I think is the major difference between Ric Wharton's *The Salvage of Century* and Keith Jessop's *Goldfinder*. While both work hard to provide for their families, Ric does this from an executive position and Keith gives the "working bloke" perspective. For example, in *Salvage of the Century*, Ric mentions that Keith had a new Porsche waiting at the dock when they returned to Scotland. This suggests that Keith is responding, typically, to his working class background and this new wealth. When I knew Ric in 1974, he was already driving an Aston Martin, what this shows I do not know. The upshot was Keith moved overseas with a reported £13,000 and Ric still lives in his Scottish castle.

*Goldfinder*, written in 1998, does not mention any events to do with the second trip. Both authors deserve to be read and together they do compliment each other well. Both are on their own are equally well worth picking up, both are equally well written.

In the acknowledgments there is a thanks to Bobby Ramsey, farmer from the Mull of Galloway, this should not be confused with Bob Ramsay, ex-Isle of Mull, occasional book reviewer.

Bob Ramsay

#### Key Words

Book review, diving operations, occupational diving, salvage, saturation diving,

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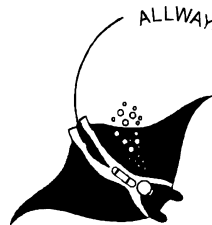
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Photo by Christopher Ross

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## SPUMS ANNUAL SCIENTIFIC MEETING 2000

### ABALONE FISHING IN SOUTH AUSTRALIA

Graham Pollard

#### Key Words

Abalone, decompression illness, equipment, occupational diving.

#### Introduction

I have been an abalone diver for 15 years based in Port MacDonnell, on the south east of South Australia. Over the years this unprotected coastline, subjected to the prevalent westerlies, has claimed many sailing ships on its lee shores. Port MacDonnell is virtually the start of Bass Strait which has the reputation of being one of the most dangerous stretches of water in the world.

There are very few protected areas along this coast where swells are less than 1 m and with the westerlies more likely 2 m. To this can be added the complications of currents, surge and poor visibility so the diver does a lot of head butting of rocks and getting the knife jammed. The few calm days that do occur each year are fully occupied with diving and rough days are used for maintenance. Because of long underwater times decompression sickness (DCS) is a real danger .

Abalone are usually associated with thick kelp and with the boat bouncing about in the rough conditions the surface supply hose can get hooked in the kelp. Movement of the boat can drag the diver backwards through the kelp, tangle the hose and even tether the diver to the bottom. In the old days that meant a rapid ascent after disconnecting the hose but now we reduce the risk of air embolism by wearing a bail out bottle and can go onto scuba for a more controlled ascent.

On a number of occasions White Pointers have been spotted off Port MacDonnell, not too far off the wharf. I have never seen any, but they are there.

#### The old days

One has to be a bit of a hunter to be an abalone diver, to be underwater for the long hours. Work usually starts early in the day and goes for 8 hours. Divers might get in the water at 9 o'clock and get out of the water at midday for about 20 minutes or half an hour to have some lunch and then back in the water. In the early days the diver would just work hard to fill his 50 or 100 kilo bag. He then would inflate the parachute and surface with the bag. The deck

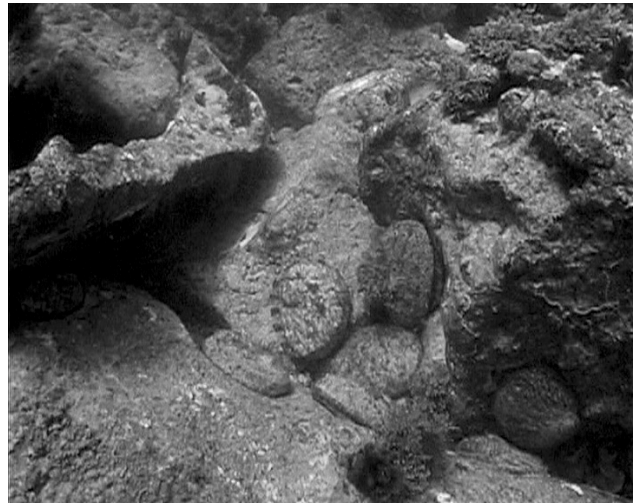


Figure 1. Abalone on rocks before harvesting.



Figure 2. Abalone in diver's hand.

hand would give him another bag and he would descend. This happened every half hour to an hour, depending on the stocks on the bottom and would continue all day. And so all day it was up and down, up and down. A pretty good dive profile, for trouble, really!

Before I came into the industry the previous license holder used to tell a story of how he would inflate the bag and hang onto it to get a ride up with it. He thought that was pretty good, because he liked the head spin that he got when he reached the surface. And he would smoke a joint on the way home after work!

We have advanced a long way from the old days with a petrol driven compressor and sometimes no one in the

boat. Two men died underwater from carbon monoxide poisoning some years ago when the compressor intake fell into the boat and into a pool of engine exhaust.

In the early days we were owner divers. The owner of the license had to dive it. We could not employ anyone. We had borrowed huge amounts of money to purchase a license, so it was just pretty gung ho and get the quota as quickly as one could to pay the loan off as fast as possible.

Most of the early divers were not trained in diving at all before they started. They picked it up as a hobby and went on from there. If they had any training it was just an open water recreational diving certificate. Now new divers coming in the industry will require a level 2 commercial training.

### Abalone diving now

There are now 32 abalone divers in South Australia working in three zones along the South Australian coast. Six of us work in the southern zone, six in the central zone and 24 in the western zone, which is near Port Lincoln. Each diver is issued with a quota of abalone to catch each year. Once the quota is reached the diver cannot fish for abalone for the rest for the year. How long it takes to collect the quota depends a lot on the weather.

Abalone diving is still intensive hard labour and not without the risk of physical injury. Today divers of the southern region wear dry suits. Unlike wet suits, the divers remain dry and warmer.

Because the divers and the State Government want to keep the abalone industry viable there are size limits on the fish allowed to be harvested as well as quotas. Divers have to report to the Fisheries Department by phone before and after each dive. The catch has to be logged onto the Fisheries computer so that they can check all catches and can make sure that quotas are not exceeded. Another requirement is that the catch has to be stored in bins, and the lids sealed, to make sure the fish are not tampered with before they get to the processing plant.

Now we can employ divers. It took us many years to convince the State Government to do this. It means we need to have our gear spot on with the Occupational Health and Safety because the employer now has a duty of care to his divers. Over the past couple of years Des Gorman and I have worked out a scheme for the South Australian divers to follow. Soon new divers coming into the industry have to become a level 2 commercial diver before they can dive on an abalone license.

Today we use a shot line that to drop another bag down, and we stay on the bottom till lunch time and just carry on, which limits the number of ascents. I limit my



**Figure 3.** Close up of G Pollard underwater, showing full face mask containing communications equipment.



**Figure 4.** Diver swimming across kelp. Note the air supply hose going to the top left-hand corner, bail out bottle on his back, buoyancy compensator and full face mask.

diving to about 15 m (50 ft), but I know of other divers who start their diving at around 30 m (100 ft) and work into the shallower water though the day.

We also use full facemasks with wired communications. Air is from compressed air banks, which are large cylinders set longitudinally in the boat's hull. This system offers lower maintenance, more reliable delivery of air than petrol driven compressors and a much quieter environment. We no longer disregard the tables, we use dive computers.

We carry oxygen and a normal first aid package on board on my boat. I do not carry nitrox. I will not use it

because I employ two other divers and it becomes too risky. A couple of the other divers in our zone are using Nitrox mixtures now. They have reported that they do not feel quite so fatigued at the end of the day.

### Diving accidents

Over the years I have had a few incidents. About 13 years ago I had DCS and was taken to the Royal Adelaide Hospital with a cerebral and spinal bend. Des Gorman was the doctor who supervised my 13 days of treatment before I was able to go home.

Twelve months later I had another little bout of DCS when my umbilical hookah line blew off at about 15 m while working in a thick kelp forest. When it blew off I thought "Oh, well it must be just here somewhere" so I was fossicking around in the weed trying to find it when I realised I still had to breathe. So I made a rapid ascent to the surface. This put me back in the chamber for another three days. Then I started to learn. Wear a bail out bottle. Better connections on the hose and umbilical and so on.

Another time I was dragged along the bottom through a thick kelp bed and got tangled up in the weed. It was worrying not being able to get to the surface and having my regulator pulled out of my mouth. The only reason I got out of that one was that I had started to wear a dry suit and I just hit the button and blew the suit to its maximum and was able to get to the surface. That was while working in about a 25/30 knot wind with a deck hand who was unfamiliar with the boat and could not start the motors. Now I have two deck hands so that if there is an accident at least one of them can drive the boat and the other can offer first aid. A stand by diver on the boat who could go down if the diver is trapped may come in the future.

### AUDIENCE PARTICIPATION

#### David Elliott

This question is based on the way that similar people dive in the Channel Islands. They begin the season in the shallow water and gradually fish that out so during the months when they were fishing, gradually work on down deeper. I guess you possibly do the same, but because of the weather you do not necessarily dive every day.

The Channel Islanders were diving every day and one of the worst bends I ever had to deal with was a man who had gradually worked into to the deeper depths and was doing basically two or three bottles on the bottom and the fourth bottle was for doing a spiral up to the surface, pseudo-decompression. Then, poor chap, his mother died so he took a week off to go to the funeral and fix the affairs, came back and the first day back he bent very badly. I believe



**Figure 5.** G Pollard during ascent. Note dive computer in right hand, abalone knife hanging from right wrist and the lifting parachute attached to the catch bag full of abalone.

it was because he lost his acclimatisation. Do you consider this business of adaptation acclimatisation as important?

#### Graham Pollard

Very much so. I had not been diving for probably 2 months and I had just got over the flu and then we did five days straight. In extremely cold water in the middle of August, and that was the time I ended up in the chamber with Des looking after me.

#### Simon Mitchell, Brisbane

I recently treated a fish collector in Brisbane whose diving profile for the day had been between 18 and 30 m for four hours and 45 minutes later he did about 3 hours at 18 m. Extraordinarily he claimed that he had been doing that sort of profile for years and years and never had a problem. Have there been a lot of divers who have got bent and dropped out of the industry?

#### Graham Pollard

They have been bent and have not been treated and a lot are still in the industry. One of our divers in Port Fairy, he only dives very shallow, probably the deepest only 12 m (40 ft) and he got out of diving last year. He was 70 years old. And he is sharp as a tack..

*The Editor thanks Mr Darren Sharam of Vortex Entertainment for permission to reproduce the illustrations all of which been provided by him.*

*Mr Graham Pollard's address is 66 Bay Road, Allendale East, South Australia 5291.*



## SOME UNFITNESS CASE HISTORIES

David Elliott and David Denison

### Key Words

Case reports, diving medicals, fitness to dive, medical conditions and problems, occupational diving, recreational diving, standards.

### Introduction

In this world of evidence-based medicine, the case history has particular importance. In addition to its customary tasks of providing a first report of some new clinical observation, a failure of some drug or procedure or any other clinical point that is valid even when  $n = 1$ , it provides an opportunity to test one's own learning and experience. If those observations challenge established knowledge or best practice, the case history becomes a stimulus to progress.

We have three cases to present, each related to a different aspect of unfitness to dive. The first raises some important basic issues. The second illustrates a fallible assumption and the last, also in a working diver, demonstrates the inappropriate interpretation and sequelae of a correct medical decision. How much can be covered in the time available will depend on discussion.

### Case 1

#### Screening a novice diver

A female, age 27, completed, in the presence of her instructor, the medical self-declaration form, required to be completed before training commences. This informs the candidate of some potential risks involved in scuba and advises them to read and discuss the statement prior to signing it.

Specifically it says *"If taking medication, consult your doctor and the instructor before participation in this program"* and *"If you have any additional questions regarding this Medical Statement or the Medical History section, review them with your instructor before signing"*.

Her answers to some of the standard questions were *Do you regularly take prescription or non-prescription medications? (with the exception of birth control)? - NO*

*Have you had or do you currently have.....*

*Frequent colds, sinusitis or bronchitis? - NO*

*Claustrophobia or agoraphobia (fear of closed or open spaces)? - NO*

*Behavioral health problems? - NO*

*History of problems equalizing (popping) ears with airplane or mountain travel?" - YES*

All the pool training and theory was completed successfully by her in the company of her husband. Their first open sea dive began with a 100 m swim from beach in the company of the instructor and his assistant. Dry suits were worn by the trainees for the first time. There was a slight swell. The instructor descended with weighted line, followed in turn by the female trainee, her husband and finally the instructor's assistant. The husband had ear problems on descent, but his wife did not notice and continued to follow the instructor down to the flat, sandy sea bed at 10.7 m (35 ft). On the seabed, the instructor was concerned that the others did not arrive. The visibility was about 3 m (10 ft). He got the trainee to kneel on the seabed about 2 m (6 ft) from the down-line and they exchanged "OK" signals. He then went to the line to look up it and saw the fins of a descending diver. He turned around but she had disappeared. She was later found drowned, with mouthpiece out and weight belt on. The autopsy was by an experienced naval pathologist and found that death was due to drowning. Importantly, there was no skin squeeze from the dry suit, or other dive-related condition or pathology.

The deceased's husband sued the instructor for lack of proper supervision (etc).

However, subsequent review of the deceased's medical records obtained from her family doctor shows that her replies on the training agency's Medical History form were not correct.

In past year, she

had been taken to an Accident & Emergency Department after loss of consciousness in the street;

had been prescribed medication for sinusitis twice in past year;

had five "panic attacks" outdoors in last 6 months;

and was on propranolol during her diving training.

Indeed she had visited her doctor on the day that she signed her medical declaration form.

The instructor was later given a reprimand by his Training Agency for not following their rules. Specifically, he had failed to refer her to a doctor because of that one 'YES' answer to difficulty with popping her ears in aeroplanes. A common problem but, if she had gone to the doctor armed with that Training Agency's Guidance, it is likely that her doctor would have read **"Absolute Contraindication: History of panic disorder"** and so she would not have dived.

Of course, if she had answered those other questions correctly in the first place, with a YES, she would not have dived at all. The defence lawyers for the instructor were saying that she was 100% responsible for her own death for

knowingly putting herself into a potentially dangerous environment. But if the wrong answers were not intended, her answers could only be a poor understanding of the words. The deceased's lawyers (who had not been aware of her medical history until disclosure by the defence) argued that the medical self-declaration form had been poorly written and would be ambiguous to somebody such as this farmer's daughter. The phrase "a history of" was linked with other phrases as unintelligible.

In his written judgement, the judge said ...

- 1 Non-referral to her doctor for her 'ears' history was, from a legal point of view, not relevant.
- 2 Her wrong answers were partly due to poor wording of the questions, but she was guilty of contributory negligence.
3. The instructor has a duty to anticipate possible panic in the first open sea dive of every novice and should supervise accordingly.

## Case 2

### Evaluating an established 25 year old male diver

At the age of 19, when a non-diver, he had a road traffic accident and, as an emergency he had a partial hepatectomy through a lower right thoracotomy. Three years later when symptomatically fully recovered, he was passed fit to dive by an Approved diving doctor and trained professionally as a compressed air diver. He subsequently passed two annual medical examinations by the same doctor for fitness to dive. However on his third annual medical examination a different doctor examined him and found "a few fine crepitations suggestive of non-compliance". With the scarring of previous chest surgery in that area the new medical examiner felt obliged to disqualify the diver from further diving and his conclusion was supported by another diving doctor. They felt that he should never have been allowed to become a diver. The diver appealed against this judgement.

A respiratory consultant reported that the diver had extensive scarring of the skin over his right lower ribs anteriorly "suggesting considerable infection locally which might have extended back to the right hemi-diaphragm. However the posterior drain scar is neat. He also has a pre-operative drain scar on his upper right chest anteriorly suggesting that he might have had a pneumothorax at the time of admission. He certainly had difficulty breathing at the time ... There are clearly many reasons why his right middle and right lower lobes might be scarred and mechanically distorted."

As it was some 5 years since the accident, whole lung function and regional lung function was then evaluated with every investigation then appropriate at the pulmonary

physiology laboratory of a leading Chest Hospital. The results are shown in Tables 1 and 2

TABLE 1

### WHOLE LUNG FUNCTION REPORT

#### PA & Lateral chest radiographs

Slightly raised hemi-diaphragm, minimal thickening right costo-phrenic angle, normal distribution of vascular markings and no abnormal shadows in the right lung apart from one linear scar in the lateral film. The latter could represent a distorted lesser fissure but later evidence suggests that if so, it is not associated with significant loss of right lung volume.

#### Auscultation

Very occasional fine noises in right lower zone.

#### Spirometry (Ohio rolling-seal)

FEV<sub>1</sub> = 4,290 ml = 66.9% TLC

FVC = 5,210 ml

Flow-Volume loop: entirely normal

#### Whole body plethysmography

TLC = 6,410 ml

RV = 1,610 ml = 25.1% TLC

#### Helium dilution

No evidence of small airway obstruction.

#### Carbon monoxide transfer capacity

D<sub>L</sub>CO - normal

#### Homogeneity of ventilation and effective pulmonary blood flow

by tracing with mass spectrometry the wash-out of 5% Argon, 3.5% Freon-22 and 1% di-ethyl ether from one breath of oxygen enriched air:

All traces are entirely normal.

FEV<sub>1</sub> = Forced Expiratory Volume in 1 second

TLC = Total Lung Capacity

RV = Residual Volume (volume left in the lungs after a maximal expiration)

D<sub>L</sub>CO = Diffusion Capacity of carbon monoxide in the lungs.

The consultant's conclusion was phrased very carefully. He said that there can never be any proof of "normality" but, in this individual, there was no evidence of sealed or poorly venting spaces in the chest. In his report the consultant stated that there was no evidence, therefore, that this diver's lungs were at any greater risk of barotrauma than those of any other member of an apparently healthy population. "Therefore, at present, we have no grounds on which, against his will, he can be deprived of his livelihood. To do so, by retreating behind clinical or diving mystique

**TABLE 2****REGIONAL LUNG FUNCTION REPORT****X-ray fluoroscopy**

During forced maximal inspirations and expirations, upright and supine: right hemi-diaphragm moves less than left but with equal rapidity.

No paradoxical motions.

**Fibre-optic bronchoscopy**

Including segmental bronchi of right lower lobe (RLL), during forced manoeuvres:

Normal.

**Single-breath Argon-Freon-Ether test** on each segment of RLL:

Normal.

*unsupported by fact, would, I suspect, be legally indefensible, particularly as he has undergone several emergency ascents over the past two years. He should win his appeal."*

So, he was formally declared fit and went back to unrestricted diving. Two years later, an emergency ascent was followed immediately by monoplegia and a clouding of consciousness from which he made a full recovery, but he then ceased diving. Was that episode of barotrauma in some way associated with his 8-year old scarring or did it just happen, as it might have happened to any other member of an apparently healthy population?

This case supports a view that one should never expose oneself to fate and declare someone to be "Fit to dive". One should recognise the limits of resolution imposed by each investigation and merely state, as was done on this occasion, that "nothing could be found that would currently contraindicate diving".

**Case 3****"Fit to resume diving"**

The assessment of fitness for the resumption of diving after decompression illness can be a complex procedure but even when straightforward, sometimes gets nowhere.

A USN Table 6 recompression, normally 4 hours and 45 minutes, was required for a student diver. The patient had only incomplete relief at 18 m and so required O<sub>2</sub> extensions before resolution, with a total treatment time of 8 hours 30 minutes. On surfacing she stayed in vicinity of chamber overnight with no relapse.

The chamber tender for her treatment was a 34-year old working diver at the diving school who, after surfacing

uneventfully from the treatment, stayed behind to clear up. Some minutes later, while turning off the lights he noticed a pain across his left mid-foot. He was told by another diver to report this to the supervisor who had taken the patient and others to a bar 200 yards away for the 'bend watch'. There, some 20 min after surfacing, the tender's pain extended up left leg and began on the right. He felt "spacey", fainted and did not regain consciousness until starting recompression. On arrival at depth, his left leg was numb with pins-and-needles, but he had no other problems. He made a full and rapid recovery with the first O<sub>2</sub> session at 18 m (60 ft) and surfaced with no further problems.

The reason for this incident was that the supervisor had failed to put the tender on O<sub>2</sub> as is required towards the end of the table when a Table 6 is extended.

After the recommended 28-day lay-off, it was confirmed that he had no residua from this "deserved" bend and an Approved diving doctor passed him as "Fit to resume diving". However he could not get another job because he was "known to be bends susceptible". This was not correct because he had suffered a well-deserved bend, so he then sued the diving school, though fit to dive, for loss of subsequent earnings and was successful. An important lesson for recompression centres.

**AUDIENCE PARTICIPATION****John Knight, Melbourne**

I think Case 2 really shows that lung function testing is a black art that does not predict what people think it is predicting.

**David Elliott**

I am glad you said that, because I believe that the resolution of even the most sophisticated lung function testing cannot take one down to the level at which the barotrauma might occur.

**Paul Thomas, Sydney**

As a chest physician I agree with that. The difficulty is that we get a false assurance from readings in physiology which cannot always be assumed to apply to the practical situation. There are two particular instances that come to mind. Physiologists originally anticipated that one would never be able to do a single lung transplant because the other lung would then inflate to such a degree that it would burst. That has subsequently been shown to be absolute nonsense and single lung transplants are now routine. Originally lung volume reduction surgery was predicted to be totally unphysiological and would kill people. We now know it is a useful procedure.

**Robin Walker, Sydney**

I just say that he conducted his own trial of pressure. He had been diving for three years and survived undamaged.

I think that most of us, if we had seen his records would have told him that these are the risks and advised him not to dive. But it is very difficult to explain satisfactorily why you are stopping him from doing something that he has done safely for three years. Pulmonary barotrauma is more common in novice divers. He was an experienced diver and I think to pass him fit was the right decision. However then once the next episode occurred, I think one would have no choice but to suggest that he does not dive.

#### David Elliott

A question that must be considered with the working diver is depriving the individual of his livelihood. And that was one of the considerations in Case 2.

Turning to Case 3 we have a student diver, a doctor doing a helmet diving experience, who required a USN Table 6 recompression after a blow up when she made a hash of her buoyancy. The inside attendant was an offshore diver who was working at the school. Because she had incomplete relief the Table 6 was extended so that the total treatment time was just over 8 hours. The dive school had failed him up by not putting him on oxygen during the final decompression when they extended the table, so this hit was his employer's fault. After that treatment he was considered fit to resume diving, but the real issue was that the diving employers knew that he had had a neurological hit, so they did not wish to employ him.

This case is a lesson to those who run chambers to make sure they get the details right. It is also a warning to doctors that just to say that a diver is fit to resume diving is not enough. In this case the doctor should have said, "He is at no greater risk than any other diver". But that did not happen so the diver sued the diving school for loss of earnings, even though he was fit to dive, and won.

#### Des Gorman, Auckland

I might add that most Workers Compensation legislation which ties employer performance to premium, most workers compensation insurance and most health and safety employment which gauges prosecution against performance, has been the worst news possible for the disabled diver, or the disabled worker, because it simply puts them out of employment for exactly this reason.

#### David Elliott

In the context of this meeting I went through the Medical Journal of Australia paper published just before Christmas 1999.<sup>1</sup> Some brief case summaries were trawled through about 50 SPUMS registered doctors and the paper showed how many considered the divers fit, how many considered them unfit and then added some comments that had been received. I have chosen three cases to discuss.

Case 1 was a fit 30 year old with a broken rib from rugby football who developed a traumatic pneumothorax which resolved. Two of the doctors said that he was

completely fit. One said it would be suicide for him to dive, and the SPUMS requirement is for a specialist opinion. Having said that, I would hope that you would consider that he would be fit to dive once everything was fully resolved. In the UK he would take about 3 months off before going diving again.

Case 2 was a 20 year old nurse with childhood hayfever and asthma, no symptoms, no medications and spirometry normal. SPUMS guidance says refer but we have covered this ground already.<sup>2</sup> Nine said fit without any referral and two said fail without any referral, so that again just illustrates where we are with the interpretation of these particular guidelines.

Case 3 is more difficult. He had a head injury from rugby football with only five minutes loss of consciousness but had a 30 second seizure, a critical factor. There may be people who would not agree with me. One respondent said there was no correlation between a convulsive seizure and epilepsy. Nine others said he was fit to dive. That meant 20% (10 out of 50) of these doctors considered that a person would be fit to dive if he had one fit at the time of concussion. I was surprised as under the UK guidance, which we went through yesterday, he would be permanently unfit to dive because he had had a fit.<sup>3</sup> In the literature that was reviewed for the HSE guidance there is nothing about allowing one seizure, as long as it happened at the time of the accident. As far as I am concerned, one convulsion at the time of the head injury, means never dive again, and that would be for a working diver as well.

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*Professor David H Elliott has been a guest speaker at a number of SPUMS Annual Scientific Meetings. He is Co-Editor of THE PHYSIOLOGY AND MEDICINE OF DIVING, which was first published in 1969, with the most recent edition in 1993 and is also the Civilian Consultant in Diving Medicine to the Royal Navy. His address is 40 Petworth Road, Haslemere, Surrey GU27 2HX, United Kingdom. Fax + 44-1428-658-678. E-mail <106101.1722@compuserve.com>.*

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## **DIVING CANDIDATES AS THEY PRESENT FOR FITNESS TO DIVE ASSESSMENT DIVING MEDICINE CASE STUDIES**

### **Part 1**

Vanessa Haller and Guy Williams  
with audience participation

#### **Key Words**

Asthma, cardiovascular, case reports, chest injury, fitness to dive, medical conditions and problems.

#### **Guy Williams**

Here are some thumbnail sketches of diving medical candidates as they walked in my front door in an area with quite a bit of dive training. All the medicals that I perform are the SPUMS recommended sports diving medical. If anyone wishes to make a comment or be somewhat critical of anything, please comment from the floor.

#### *Case 1*

This fellow, 18 years old, had wheezes when he was a child which is very common in Australia. In Australia, particularly the southern parts, probably 25% of children have wheezes at sometime. It is a very common presenting symptom in young children, particularly in my area. He thought he occasionally wheezed when he ran. His lung function tests were in the normal range, Forced Vital Capacity (FVC) 3.58 l (4.00) and Forced Expiratory Volume in one second (FEV<sub>1</sub>) 3.03 (3.31). Because of his history of asthma and the query about exercise induced asthma, I performed a hypertonic saline challenge test which was negative. The candidate's lung function is measured before and after 0.5% saline solution is breathed through an ultrasonic nebuliser. A 15% drop is a positive result. This test is commonly performed in Australia. However in many other parts of the world an exercise test is more commonly performed. David Elliott would you care to comment on whether one should do hypertonic saline or exercise testing or both?

#### **David Elliott, Guest speaker**

Where I come from, which is the world of the commercial diver, pulmonary function is tested before and after six minutes of hard exercise. If the test results are virtually unchanged, and provided they have not got any triggers that could be active, then they are fit for diving.

#### **Guy Williams**

I passed this person. Does anyone disagree with that?

#### **Simon Mitchell, Hyperbaric Physician, Brisbane.**

Did you issue this gentleman with a SPUMS statement of health for recreational diving or did you write fit for diving on his RTSC (Recreational Scuba Training Council) statement?

#### **Guy Williams**

I always use the medical certificate in the SPUMS medical, which is that based on informed consent. I often give anyone with a history of asthma an article that Carl Edmonds wrote some years ago in Scuba Diving. It is extremely negative towards asthma and diving. I tell them to "Take it home and read it well, just so that you know why we have this interest in asthma and diving".

#### **Simon Mitchell**

Well in that case I agree entirely with your decision.

#### **Henrik Staunstrup, Denmark**

In Denmark we had a number of deaths from pulmonary barotrauma in asthmatics and the respiratory physicians, who use methacholine to provoke airway narrowing, suggested that we use that to test asthmatics. Why do Australians use hypertonic saline?

#### **Guy Williams**

I like to use hypertonic saline because I can do it myself in the consulting room. Methacholine testing has to be done in a respiratory laboratory which means another appointment and delay. Many patients want to have the results right away as they want to start their course that evening!

The conventional tests for possible airways hyper-responsiveness are histamine and methacholine challenges. In a clinically-based asthmatic population there is about an 80% positive rate. In a normal population, never had symptoms of asthma, there will be something like a 25% positive rate. Depending on the prevalence of the disease in the sample of the population one is examining there will be a lot of false positives if your respiratory specialists are trying to absolutely exclude anyone with asthma. If, on the other hand, one is trying to mimic the environmental triggers that the potential diver may be exposed to, then saline has some justification. Neither of the tests, to my knowledge, has any outcome to assess its actual validity as a discriminative test.

#### **Deborah Yates, Respiratory Physician, Sydney**

This is something which has been extensively discussed at the Australian and New Zealand Thoracic Society and, as a whole, the points that you make are true. There is really no evidence to implicate any sort of challenge testing with regard to diving. The reason that people do hypertonic saline challenges is because they are easy. They

replicate the apparent nature of diving and they are less often positive. As a group the Thoracic Society are not terribly happy about excluding absolutely everybody with asthma from diving. The other point is that, unfortunately, it is actually very difficult to use methacholine in Australia. It is not licensed for use and one has to get a special licence from the Therapeutic Goods Administration in Canberra, although it is actually quite an easy test to do. We are quite happy with hypertonic saline because a smaller proportion of people will be positive and those that are will have probably quite severe bronchial hyper-responsiveness but of course the fact is that bronchial hyper-responsiveness is not asthma. So a positive test it does not necessarily mean that somebody has asthma and therefore one should really take into account a whole lot of other things as well.

### **Henrik Staunstrup**

This just reflects the differences in the different parts of the world. In Denmark we do not use hypertonic saline challenges. Our specialists all use the methacholine test so that was what they recommended to us to use.

### **Guy Williams**

#### *Case 2*

A 16 year old schoolboy who had been diagnosed as an asthmatic as a child and who had not used salbutamol (Ventolin) for three years came for a diving medical. His lung function test were FVC 3.70 (4.35), FEV1 3.12 (4.07) and FEV1/FVC of 84%. With his history of asthma and because he had used Ventolin until 3 years ago I gave him a hypertonic saline challenge test. Within a couple of minutes he dropped his lung function by about 30% and, although he denied it, was sounding quite wheezy and not looking as good as when he had walked in. I gave him some salbutamol (Ventolin), which reverses these people very quickly, and his lung function had returned to normal before I let him out of my clutches. On the basis on this, I thought that he had a significant risk of becoming seriously wheezy while diving and failed him.

I wonder, would this boy have been passed in other countries before he had the saline challenge test, or would he have passed afterwards, or would most people in most countries under most systems have passed him? David Elliott can you tell us what would have happened in England?

### **David Elliott**

I still say that we should do the exercise tolerance test on everybody. This opinion came out of an UHMS meeting "Are asthmatics fit to dive?".<sup>1</sup> The person whose opinion we relied on was Mark Harris, who is familiar with the resuscitation of surfers but is primarily an asthma physician, who also looks after high performance athletes. It was his considered opinion that, providing a person has not got any known triggers and is not on medication other than corticosteroid, then the real hazard for the asthmatic is not barotrauma. The real hazard is not being able to get enough air to escape from an emergency situation. That is

why the exercise tolerance test is the one that is pushed and the considered view of pulmonary physicians was that if one has to go as far as any challenge test, one has already gone past the point at which the diving candidate should have been rejected.

### **Guy Williams**

#### *Case 3*

This 18 year old student wheezed as a child. He had used salbutamol (Ventolin) from time to time. There was no history of exercise induced asthma. Lung function was FVC 4.75 (4.03), FEV1 4.34 (3.75). Perhaps because I had read something about exercise testing recently I got him to do an exercise test, running up and down a nearby hill, when he came back he looked as if he had been working quite hard. But there was no change in his respiratory function. So I assessed him as being fit. My practice is always to have a chat with these people about why asthma and scuba diving are a potential problem.

### **Barbara Trytko, Consultant in Intensive Care and Hyperbaric Medicine, Sydney**

It is my understanding that a number of asthmatics do not actually get exercise induced asthma and under those circumstances the exercise test would not be positive. However if they are diving, when they breathe cold dry air, with a faulty regulator that is nebulising a bit of salt water they might, even with a normal exercise test in the dry, develop broncho-constriction and become significantly incapacitated.

### **Guy Williams**

I find that asthma is commonly misdiagnosed. Many things are called asthma, and are not. I can recall one young lady who said she wheezed but only when she patted horses. She was otherwise fit and well. I could see no reason for her not to dive.

Many people have wheezed. I wheezed when I had bronchitis two years ago, but that is the only time I have wheezed in my life. That is not asthma.

The SPUMS policy on asthma and diving was formulated in 1995 at the Annual Scientific Meeting in Fiji.<sup>2</sup> The discussion suggested that the sub-group of asthmatics that we particularly wanted to identify were those with exercise induced asthma, because it was thought that they were the people most likely to get into trouble diving. It was also thought that the real problem was not ascent from depth, but the swim back to the boat in the choppy sea. This is where asthmatics get wheezy, short of breath and drown. Anyone who is having trouble staying on the surface is likely to drown and those few asthmatics that have died when diving have drowned.

### **Mike Bennett, Hyperbaric Physician, Sydney**

Maybe the respiratory physicians amongst us will know the answer, but is there any evidence that asthmatics suffer proportionally more disasters in the water than others who are struggling to stay afloat?

**Paul Thomas, Respiratory Physician, Sydney.**

There really is not very much in the way of evidence at all. This was brought up in our discussions at the Australia and New Zealand Thoracic Society, who have produced a statement on Asthma and Diving.<sup>3</sup> I have tried to trawl through the literature looking for evidence of increased risks for asthmatics in diving incidents and I cannot find any. There is nothing on swimming and asthma risk, nor on very labile asthmatics and diving.

**Paul Langton, Cardiologist, Perth**

The best evidence comes from Douglas Walker's book on Australian Diving Deaths 1972-1993 which highlights what we know about the asthmatics who died.<sup>4</sup> One died in an unrelated fashion (sudden cardiac death). The majority died on the surface (5 of 9), mostly from drowning whilst swimming in difficult circumstances. In only two cases was asthma considered a "significant factor" (both drowning), and there was only one case with confirmed pulmonary barotrauma. In a further case, the diagnosis of asthma was based on autopsy "changes in the lungs" rather than on any clinical history of asthma.

**John Knight, Melbourne**

The thing about the asthmatics who have been collected as dead bodies out of the Australian seas is that there have not been very many. One drowned because when he came ashore at the end of his dive he started to wheeze. Instead of walking around the little cove he went back into the water to swim across to get his Ventolin. He never got there. So acute asthma can really ruin your swimming.

**Guy Williams***Case 4*

An 18 year old student who had wheezed a bit as a child. He gets quite a lot of hayfever. Lung function FVC 4.39 (4.49) FEV1 4.06 (4.20). Because of his history of wheezes he was given a saline challenge test, which was negative. I decided on the basis of that, that I had enough evidence to front the coroner and passed him with an informed consent.

*Case 5*

Now this one illustrates another point that might be relevant. He was a 27 year old tourist who was working in Australia on holiday. He was a college athlete who competes at a fairly high level. He claimed that he had exercise induced asthma when he ran and when he ran, he meant he was competing at maximal effort. He said that when he was at peak performance he felt a bit wheezy. His lung function was FVC 5.80 (5.40) FEV1 4.62 (4.54) FEV1/FVC 80%. We had a long discussion about asthma, the risks of asthma and diving and I did a saline challenge test on him which was quite negative. On the basis of an informed consent, with a history of perhaps exercise induced asthma there may be some risk above the normal, I passed him.

My assessment, based on a study of one or two, is that the average non-Australian diving candidate is much

more honest than Australian diving candidates. I do not know whether it is the dive shops or their mates, friends at school or other parties but I think that many diving candidates are informed by various parties that if you say you have had asthma, they are going to fail you. It seems to be particularly common amongst Australians that they like to bend the truth a little bit on these medical statements.

*Case 6*

A 27 year old fitter had hayfever and asthma as a child. He had not used bronchial dilators for years and years. His lung function was FVC 4.34 (4.84) FEV1 3.84 (4.18) FVC/FEV1 86%. I suspect that he was probably one of those who bent the truth a little bit as to how much trouble he really did have with asthma. When I did a saline challenge test, it dropped 30% very quickly and he became quite wheezy and was obviously uncomfortable and I failed him.

*Case 7*

A 17 year old student who gets hayfever and is wheezy when he has an upper respiratory infection. He claimed to get a bit of exercise induced asthma but I have found that exercise induced asthma is often misinterpreted as getting a bit puffed at the end of a run. Lung function was FVC 4.31 (4.35) FEV1 3.79 (4.07) FVC/FEV1 88%. I did a saline challenge test on him. And his dropped 15% over the duration of the test. According to the protocol that I use 15% is a cut off point so I failed him. Perhaps I may have been harsh.

**Simon Mitchell**

We use 20%. I just wanted to go back to the previous case. It appears to be a case of childhood asthma with no wheezing on the history or use of broncho-dilators for years. Now some people would say, and I am probably one of them, that on the basis of that history I would have passed him to dive without doing a test. Do you challenge everybody who has got any history of asthma, because that appears to be what that case indicates.

**Guy Williams**

The answer is that it depends on how I assess the honesty of the candidate in talking to them.

**Simon Mitchell**

I totally agree with that.

**Guy Williams**

Often in medicine one has a little voice that says, I should do this to this person. I can do the tests relatively easily. I quite like doing them because I give the candidates a real earbashing on diving medicine while they are doing it. And it is partly out of interest.

**Simon Mitchell**

Would you necessarily test someone with a childhood history of asthma with no medications for 10 years?

**Guy Williams**

It really depends on how I assess the honesty of the candidate. When I do diving medicals I do everything myself so I spend a fair bit of time with the candidate. I feel that because it is known locally that I do everything myself, and therefore it can be done relatively quickly, they seem to refer me all the difficult ones. The failure rate in recent diving medicals has probably been 25% which is just getting ridiculous and it has all been for asthma.

*Case 8*

A 22 year old plumber with hayfever who had wheezed as a child. No history of exercise induced asthma. He surfed regularly and never wheezed. I did a saline challenge test on him and he dropped about 20% in 6 minutes. Does anyone have any comments on this chap who actively partook in watersports and could swim and splash and get dumped in the waves. He denied all histories of wheezes but he has obviously got reactive airways. Did I fail him unfairly?

**Unknown speaker**

Can I be the devil's advocate. With people with vision problems, we just have them dive with their corrective lenses or contact lenses. Is there any good science behind not telling people to use their inhalers before they go for a dive and letting asthmatics that are on the borderline dive?

**Guy Williams**

I think the thing at the back of our minds is that I like to do things that are in the ballpark of what my colleagues are doing and so I can find somebody else to come with me to the coroner's court and say that I did the right thing. A year or two ago, someone on the SPUMS diving doctors list did a medical on a man who did not declare a history of asthma and I gather had normal lung function. Shortly after his course he died diving and it was thought that asthma and panic was responsible. The doctor was grilled in the Coroner's Court and he really did not enjoy that. The lawyers gave him a hard time trying to blame him for passing the deceased. A lot of the things that we do are based on what our colleagues do, and whether we can get other people to come to the Coroner's Court and say "Well I would have done the same thing".

Is it alright to have a puff of Ventolin (salbutamol) just before you dive? Is there any scientific evidence that it is not good practice?

**Simon Mitchell**

There actually is some data that suggests that a bronchodilator just then is a bad idea.<sup>5</sup> Brian Hills showed that the use of a bronchodilator, theophylline, not only dilated the airways but also dilated the vasculature and allowed venous nitrogen bubbles to traverse the pulmonary bubble filter. Although the deleterious effects of that happening have not been proven, it is theoretically a bad thing. So probably not a good idea.

**Guy Williams**

At the previous meeting in 1995, it was suggested by a number of respiratory physicians that budesonide (Pulmicort) taken prophylactically blocked the response to hypertonic saline and exercise. Would somebody, with normal lung function, whose only medication is budesonide which is controlling their asthma perfectly, be fit to dive? Should you pass them? I do not. I think most people would fail them, but perhaps we are failing them unnecessarily.

**Simon Mitchell**

I would fail them because I would view their asthma as potentially not being well controlled.

**Henrik Staunstrup**

Divers on Pulmicort in Scandinavia who have normal lung function are allowed to dive. But they have to go through a methacholine test and if they still have normal lung function they are considered as having normal lungs so they can keep on diving.

**Guy Williams**

Here is a problem that is becoming increasingly common and it gives cardiologists something to talk about.

*Case 9*

This 63 year old man was quite an experienced diver. He had been diving for 17 years. He had a small anterior infarct a year before I saw him during a clean up dive in one of the local bays. The chest pain actually occurred on the surface and his buddies, who were nurses, thought it sounded cardiac and called an ambulance. He had an angioplasty and a stent. When I saw him he had returned to normal activities. He was back at work. He was back at the gym where he went regularly and he was exercising at the same level he had been to before. His post-angioplasty and stent exercise and thallium tests were negative. When he came to see me before resuming diving he was on Capoten (captopril), Pravachol (pravastin sodium) and aspirin. He came with copies of all the various reports from his cardiologist and local doctor. We had a long chat trying to inform him of the potential risk of diving now that he was back to a normal life again. I told him that I thought he was safe to resume diving, although if he had a sudden arrhythmia or a massive heart attack while he was diving he was likely to die. He was happy with that. In some ways he probably has the advantage that unlike most of us he knows what his coronaries are like. Does anyone have any comments on returning to dive after coronary artery surgery, coronary artery stents?

**Unidentified speaker**

I not only do scuba medicals, but I am also the chief medical assessor for CAMS motor sport in Victoria and we have got exactly this sort of problems with people who want to take up motor racing again. This man would be allowed to go motor racing, not at a senior level, but certainly for club meetings. I would allow him to dive if he wanted to.



**Paul Langton**

A couple of minor points. Firstly one needs to know his left ventricular function which they would know, and you do need to know what exercise capacity he reached but he could probably give you that verbally.

There are a couple of key issues in a case like this. One is that the vast majority of myocardial infarctions occur on the basis of a sub-critical stenosis, a 30% or 40% lesion which will not be picked up by an exercise stress test or a thallium test. This is a level of stenosis which many of us in this room will have.

So the negative stress and thallium tests are of little reassurance. Most infarctions occur either from an acute sympathetic nervous system stimulation, i.e. from unaccustomed exercise or in the early morning. The rest of them are probably from an inflammatory type stimulus which we cannot do anything about.

But we can prevent the sympathetic nervous system stimulation with a beta blocker. If, in the absence of contraindications, someone was going to engage in any sort of very vigorous physical activity I explain to them the mechanism of infarction and recommend they be on a beta blocker.

I tell all divers that they should be swimming fit before they start diving. Once you are swimming fit the unaccustomed component becomes less of an issue, but I tell males over 45, females over 55, and anyone else who might be at high risk, that they should have at least an exercise stress test before taking up any physically demanding exercise. Because you want to pick out the one that has got asymptomatic but critical coronary disease because they do die quite regularly.

**Simon Mitchell**

I would be worried about immersion induced pulmonary oedema. I have treated five cases and three were on beta blockers. For that reason I would suggest that it is not wise to dive while you are beta blocked.

**Bill Brogan, Perth.**

If I could present a series study of two. I have coronary artery problems although I have never had any major cardiac problem and I am on 40 milligrams of atorvastatin calcium (Lipitor) a day to reduce my cholesterol.

I think the key things in this sort of assessment are

- a I have had a good life and so if I do die doing something I enjoy doing, that is fine by me.

- b I have been diving for 52 years and I have got some idea of what I am doing, what I can and cannot do.

My son, 44 years old, has had a triple bypass. He is also medically qualified and in his clinical opinion now after 2 years, he is fit to dive again and is diving. My son is also pretty experienced.

Surely these are the factors we are going to look at in evaluating these things, which comes back to informed consent. What does the patient know and how sensible is he? And how experienced.

**Guy Williams***Case 10*

One of the doctors in our area who has a very small ventricular septal defect (VSD) and I prevailed upon her to have an echo and a stress echo, more out of interest than anything else, to prove that she had no left to right shunt which, of course, she did not and I gather with small VSDs that situation probably never occurs. On the basis of an informed consent, and she could make quite an informed consent as a medical practitioner, she did a dive course. She has stopped diving because she took up sailing.

*Case 11*

This 43 year old is a fanatical triathlete, performing at a fairly high level. He had congenital complete heart block and a bipolar pacemaker has been inserted. He brought along the details of his pacemaker. The manufacturer recommends that, with that particular model pacemaker, you dive no deeper than 30 m (100 ft) on the basis that below 30 m their studies have shown there was some deformation of the case but performance did not alter. On the basis of an informed consent and subject to that depth limitation which he was more than happy with, I passed him as being fit to dive. Anyone have any comments?

**Barbara Trytko**

There have been studies done in the hyperbaric environment that demonstrated that although permanent pacemakers worked very well up to three atmospheres, beyond that some do fail unpredictably.<sup>5</sup> The interesting thing was when pressure was reduced they restarted working perfectly normally again.

**Guy Williams**

Another problem group has appeared recently, those who as children have had congenital defects repaired.

*Case 12*

This 26 year old student had his patent ductus repaired when he was quite small. He was otherwise fit and well. So I passed him.

*Case 13*

This 28 year old farmer had a hole in his heart (ASD) repaired as a child. Again I could find no reason not to pass him.

*Case 14*

This 40 something year old diver, who happens to be a doctor, had the misfortune to be stabbed in the chest by one of his patients during a consultation. As a result he had bilateral tension pneumothoraces and a penetrating wound to his heart. His right main bronchus was severed. The

necessary surgery was done through a sternotomy. Now he has asked me "Can I dive again". We had a bit of a chat about informed consent and I suggested that he have a proper diving medical. Other than having survived those injuries he a normal person. At the moment he is not diving. In people who have had open heart surgery and penetrating chest wounds we worry about adhesions and other things that may predispose them to a pulmonary over-pressure event. Are these people at any significant extra risk when they want to dive, or if they want to dive again?

#### **Paul Thomas**

From the point of view of his pneumothorax he should not have underlying structural lung disease so you would think that he should not be at risk. If one has got blood in ones chest that often causes scarring between the two layers of pleura so therefore one is much less likely to have another pneumothorax. The other point is that the scarred lung will be abnormal and there is the possibility of an over-pressure event, but I do not know of any information about the risks.

#### **Guy Williams**

It seems to me that he fits within concept of informed consent. That one can explain the risk to him and he can decide for himself what to do. I think his extra risk is probably not all that high. But, as we discourage people with penetrating chest injuries from diving, there is no evidence.

#### **Cathy Meehan**

The Australian standard says that a penetrating chest injury is an absolute contraindication, so you have to be really careful.

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## **DIVING CANDIDATES AS THEY PRESENT FOR FITNESS TO DIVE ASSESSMENT DIVING MEDICINE CASE STUDIES Part 2**

Vanessa Haller and Guy Williams  
with audience participation

#### **Key Words**

Barotrauma, cardiovascular, case reports, decompression illness, dysbaric osteonecrosis, injury, medical conditions and problems, pulmonary barotrauma, spear fishing.

#### **Vanessa Haller**

General practitioners do a lot of the screening of new divers but we also see them after they have been diving for years when they come in with problems. Unfortunately we cannot do much to prevent them diving or from continuing to dive and sometimes we need some help in how to deal with these problems.

#### *Case 15*

I only met this gentleman two weeks ago, when I was visiting his mother. He is a 46 year old professional underwater photographer. This story came up in conversation. About 8 years ago, in South Australia, he had some sharp pain in the left side of his chest with a little bit of shortness of breath, but he ignored this, thinking that it was muscular. The next day he went for a dive and was separated from his buddies. He was in a bit of a surge. He surfaced to look for them and became short of breath on the surface, so feeling that he was better at depth, he went back down again, because then he was less short of breath. Eventually he had to surface because he was running out of air. When he surfaced he had severe shortness of breath, severe left sided chest pain and collapsed. Obviously on the day before the dive he had had a spontaneous pneumothorax which had become a tension pneumothorax by the time he reached hospital. He had a surgical repair of his pneumothorax. Six weeks later he was given the OK to continue diving and for the last 8 years has been diving quite successfully with the repaired pneumothorax.

Diving is his income. He has no obvious bullae on chest X-ray now. Would anyone like to comment on this?

#### **Unidentified speaker**

A spiral CT or a MRI for studying the lung should be done.

#### **Deborah Yates, Respiratory Physician, Sydney**

I know what respiratory physicians might do but that might not be what is recommended by diving specialists. I think this man is actually at a significant risk. Whenever anybody has had a single pneumothorax I always worry about disease on the other side. His surgical repair should mean that he should not have another one that side. But I

would be worried about the other side. I would like to get full lung function tests and also a CT scan just to make sure he has not got any bullae, as a chest radiograph is not very good at picking them up. The other thing I think would be useful to ask about his smoking history and in particular, also about his history of smoking marijuana, because that appears to be associated with upper lobe bullae.

#### **Vanessa Haller**

He is a non-smoker, but I did not ask him about marijuana so that is interesting. According to the Australian Standards, anyone with a spontaneous pneumothorax should be excluded from diving.

#### **Mike Bennett, Hyperbaric Physician, Sydney**

I accept that there is great intellectual interest in all those marvellous investigations but they are irrelevant. This man could be counselled that he is at a significant risk and he should be fully informed. He should be told that if he wants to dive again to never ever associate your name with that activity.

#### **Vanessa Haller**

##### *Case 16*

This 50 year old abalone poacher, who had been diving for years, was working in shallow water where there was a large swell. As he was poaching it was a night dive. He was concentrating on the abalone and he was going up and down in different depths without actually noticing. On surfacing he had a lovely Donald Duck speech and clinically he had subcutaneous emphysema. He said he had no previous decompression illness (DCI) but his sharpened Romberg test was only 10 seconds. On chest X-ray he had mediastinal emphysema. He refused any suggestion of recompression treatment. He did however, let me give him some oxygen and the Donald Duck speech settled to a certain extent, so that he sounded normal within 24 hours and all the subcutaneous emphysema settled within about 48 hours without doing anything. I counselled him not to dive but he continues to dive and probably is still poaching abalone and he is at risk of doing that again.

#### **Robyn Walker, Naval Hyperbaric Physician, Sydney**

If one tells people the risks and they continue to undertake the activity, surely that is their responsibility? I do not lose too much sleep if people do not want my advice. On the information given that I would suggest that he does not dive again.

Certainly there is some evidence that the sharpened Romberg time is reduced in people with decompression illness.<sup>1,2</sup> I do not fail people at diving medical because they can only do 10 seconds. I examine them to make sure there is no other problem. A lot of people actually improve with just becoming familiar with the test. Various people do sharpened Rombergs in bare feet, others do it in shoes. I have seen one girl who could only do it in stiletto heels, because she normally wore stilettos. She could not do it at

all in bare feet, but she when put her stilettos on she was perfect. I think one just records what they can do.

#### **Vanessa Haller**

The sharpened Romberg, which we do as a screening test when we first do a fitness to dive, is a test of the balance system. We like someone to do it for sixty seconds and we do not take any notice if they cannot do it initially, because they do improve with practice and with shoes or bare feet and which foot is forward. But later on when they are having a diving incident, how important then is it if the sharpened Romberg drops dramatically and stays low?

#### **Robyn Walker**

I ask the people I treat whether they did the sharpened Romberg when they did their dive medical. If they say yes they could do it and they did it for the required time, it gives me an indication that something is wrong if they fall over within one to two seconds. However, the diagnosis is always going to be based on the clinical picture, the history of the dive and ones positive findings.

#### **Vanessa Haller**

##### *Case 17*

This was a 38 year old professional abalone diver with years of diving experience. One day he was playing some social tennis and injured his shoulder. This brought him to me. He had very poor short term memory and his speech was slurred. His sharpened Romberg was about 10 seconds. X-rays showed quite severe dysbaric osteonecrosis (Figure 1). He had an A4 Juxta-articular lesion, a severely damaged joint with a loose fragment.<sup>3</sup>

He was unsure whether he had ever had DCI. I suggested that he give up diving but that was unacceptable and anyway he was more comfortable under water.



**Figure 1.** There is an A4 Juxta-articular lesion in the humeral head which has led to a severely damaged joint with a loose fragment of humeral head cortex.

He was an abalone diver in Tasmania and he had a lot of diving deeper than 30 m and for very prolonged times. They would often be in the water up to 8 hours a day. He continues to dive, because that is his living and he did not have any treatment for it. Not that there is much in the way of treatment, as he needs a new joint and shoulder replacements are not very good at the moment.

#### Case 18

This unfortunate 28 year old sport diver stood on a stingray in Port Phillip 14 months ago. He got an exceptionally painful puncture wound to his foot. He went to the local hospital and they had no idea what to do for a stingray injury. They were uncertain whether or not there was a foreign body or whether it was toxin or trauma. The whole foot was quite inflamed and red and lacerated. They eventually put it in hot water as they had been advised to over the phone. He was quite pain free in the hot water. That was the best he felt for the 14 months. They operated on the wound and the debrided it. They found no foreign body. They put him on long term antibiotics. He continues to return to hospital because the foot is painful. Ultrasound just shows some swelling. The surgeons have further debrided it and given him further antibiotics and that has only been helpful for very short periods of time. He had an injection of local anaesthetic and steroids into the area which helped again only for a short time. The wound has completely healed but it remains painful. Does anyone have any ideas of further management of this foot?

#### Unidentified speaker

He has probably got an altered pain threshold and needs to see a pain therapist.

#### Alan Walley, Christmas Island

We treat them a bit better than that on Christmas Island. Has he had any bone X-rays? Was the bone involved at all?

#### Vanessa Haller

The bone was not involved. He has had a bone scan.

#### Jürg Wendling, Switzerland

Another point to be considered is whether there is some iatrogenic nerve trauma provoking the pain. Being a hand surgeon I have seen many cases of that kind that have been revised many times, and then finally one treats the consequences of the revisions.

#### Vanessa Haller

##### Case 19

This 26 year old male is an unusual case. Like many people he had fillings in his teeth. He did a full day's diving, 25 m for 1 hour then, a 3 hour surface interval, then 1 hour at 18 m. He had no problems equalising. Driving home they went up a small hill and there was a bang. The driver thought he had a blown a tyre. The patient knew it was not as a whole tooth has completely disintegrated in his jaw.

##### Case 20

A 22 year old student had problems equalising during his dive course. This is a common problem. On ascent he had some pain and vertigo. Clinically he had barotrauma to the ears and it was thought he had a round window rupture. Treating round window rupture is difficult because the ear nose and throat specialists all treat them differently, even if they have got an interest in diving. The management varies between doing nothing, giving them steroids and immediate surgery. We are now also seeing a lot of round window injuries in underwater hockey players.

Has anyone had any new information on treating round window rupture?

#### David Elliott

I certainly have no new information. But basically there are Carl Edmonds,<sup>4</sup> Fred Pullen from Miami, Joe Farmer from Duke and Bill McNicoll in the UK and I think that they would all say that one has to operate within 24/48 hours. Waiting for 5 days to see if recovery occurs is wasting opportunities to save hearing.

Recently Bill McNicoll spoke at a Medical Assessment of Fitness to Dive meeting. His first remark was "Are there any ENT specialists at this meeting?" There were none. His comment was "That shows the amount of interest ENT surgeons have in diving." The next comment was "What do ENT specialists know about diving? Nothing. How good are they at treating round window rupture. Not very good." In the UK, ENT surgeons do not know very much about round window rupture and some of them have never even heard of it arising from diving.

It is a question of education. Key articles are Pullen who first described it about 15 - 20 years ago.<sup>5,6</sup> I know Carl Edmonds wrote something about it around that time.<sup>4</sup> Bill McNicoll has also written on this.<sup>7</sup>

All you can do is to get hold of your local ENT surgeon, send him a few referrals and get him interested in the subject. Until that happens, we will continue to get permanent deafness from something that could have been fixed with an urgent operation.

#### Henrik Staunstrup

A question for the audience. In Denmark we have a problem with a commercial diver who dived on a sunken fishing boat. He did a forceful Valsalva on his way down after which he started to get vertigo. On his return to the surface he had nausea and tinnitus, all the symptoms of round window rupture. He still has tinnitus today. We have presented him to the insurance company as a round window rupture. The problem is that he has it in both ears. Has anyone here ever heard of that happening? Because our ENT specialist tells us his troubles have nothing to do with diving because he is affected in both ears. But the onset was definitely when he went down to that sunken fishing boat. As he is also an ambulance driver there is possibility of noise damage from the sirens which usually only causes for minor deafness.

**Simon Mitchell**

I have never seen a case of bilateral inner ear barotrauma. But statistically it has to be possible. I think that it would be incredibly rare to get inner ear barotrauma with bilateral hearing loss that is symmetrical. But it has to be possible.

**Mike Bennett**

I wholeheartedly agree with David's bleak outlook. However, in Sydney we have an excellent ENT surgeon who has become very interested in the treatment of round window fistulae and we preferentially send all the round window ruptures we can find to him and he operates early. But he has got so interested that he sends us patients and says this patient has such and such a history, not dissimilar to yours from Denmark, although I have never seen a bilateral one, and he wants us to see if we can reproduce the problem by giving the patient a dip in the hyperbaric chamber. We do audiograms before and after and are drawing some conclusions from that.

**Robin Walker**

I have seen a patient who had a bilateral round window rupture. She was inexperienced and had difficulty clearing her ears. On one dive in Vanuatu she did a forceful Valsalva which produced severe hearing loss, tinnitus and vertigo with nausea and vomiting. No audiogram could be done there so she was evacuated to Australia. She had a normal audiogram at her diving medical. Now she had a 70 dB loss in one ear and a 90 dB loss in the other ear. She was operated on and a fistula with leaking fluid was observed bilaterally. That is the only case that I know of.

**Mike Bennett**

Our ENT surgeon says that his experience makes it difficult to believe that people see these fluid leaks. He has shown me in the theatre that the middle ear is moist, it is wet, there is fluid all over the place but he never seen fluid welling up.

**John Knight**

For those who do not believe that there are fistula that can be seen leaking, I have photographs, taken down the side arm of the operating microscope, in two cases of diving round window rupture, showing a drop grow, and then collapse as it grew too large to remain a drop, on the round window.

**Unidentified New Zealander**

Our ENT surgeon in Auckland says that a leak from a round window is actually quite a hard thing to see.

**David Elliott**

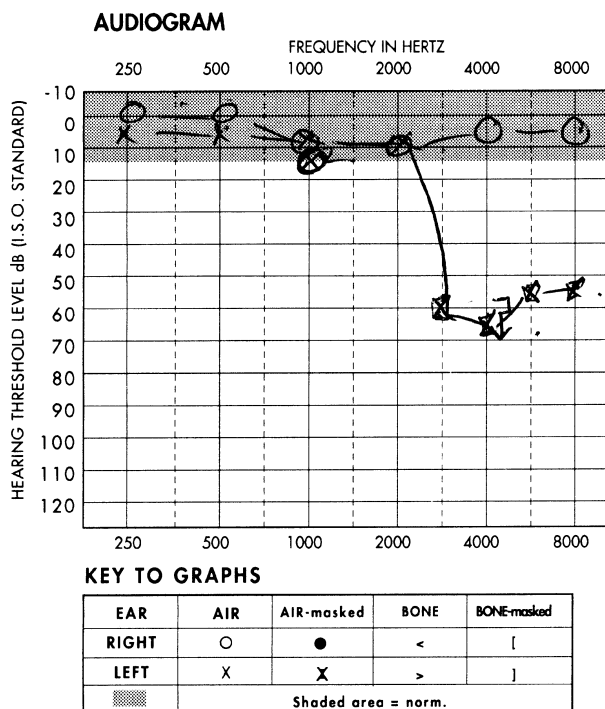
I was very encouraged by hearing that the British Thoracic Society and the Australian and New Zealand Thoracic Society are individually preparing standards of care in their specialist fields. I wonder if this Society has one or more ENT surgeons whom we might ask to do the same for

diving related round window ruptures? It is apparent from Vanessa's case that there is a need for a standard of care that can be used by an ENT surgeon who has no knowledge of diving. There is a 24 to 48 hour threshold before permanent damage occurs. Those who repair round window ruptures say they get about a 98% recovery and what is more, these persons, provided that they no longer have any difficulty in clearing their ears, can return to diving.

**Guy Williams**

*Case 21*

This patient of mine, a relatively inexperienced diver, developed decreased hearing and tinnitus in his left ear after a dive. Like most divers he rolled up a few days later. He had quite a severe high tone hearing loss in his left ear (see Figure 1). The first ENT surgeon that I referred him to said wait and see. After a few days the patient came back to me saying "I'm not getting any better, I do not want to wait and see". So I sent him to a second ENT surgeon, with diving experience, who basically said "I do not think there is much we can do for you. I would really encourage you not to dive again". That advice was not accepted. He is still diving. And there were no real precipitating factors. He just came up after the dive and noticed that he could not hear properly out of one ear.



**Figure 2.** Patient 21's audiogram showing significant high tone loss in the left ear.

**Vanessa Haller**

*Case 22*

Spearfishing seems to be having a resurgence, as does a lot of breathhold diving and underwater hockey. This young boy was spearfishing with a gun without a safety

catch on the trigger. An accidental release of the gun left him with the pranger in his nose. Figure 2 shows the pranger spikes, cut free from the shaft, in the patient's face before their removal. The pranger was removed piecemeal as the barbs prevent the spikes being pulled out backwards. Figure 3 shows the patient's face after the spikes had been removed and an intact pranger laid across the face to show its size. At the end of the operation he looked quite reasonable.

Unfortunately diving doctors will come across spearing accidents. Should spears have a safety catch or not? Most of the spear fishing people do not use safety catches. The reason is if the safety catch is off one knows that the spear is always ready to fire. Nowadays, particularly in deep water spearing, people are diving in pairs, so there is less of a risk of people drowning when they black out from anoxia after hyperventilation. In most states of Australia and in New Zealand it is either illegal or unethical to spear fish on scuba. But in many places, like Fiji, people do spear on scuba.



**Figure 3.** The patient's face showing the four pranger spikes cut short.



**Figure 4.** A pranger held over the patient's face to show the length of the prongs.

### Case 23

Our last case is a cautionary tale. A very experienced, over 20 years of diving, male surgeon, who swims daily and is accustomed to having quite firm goggles on his eyes, bought himself a new mask. He does not need to equalise his ears often during descent. He forgot to equalise his mask and came up with subconjunctival haemorrhages and subcutaneous haemorrhages with marked swelling which took about two weeks to resolve. A severe mask squeeze which could have been easily avoided by blowing air into the mask.



**Figure 5.** Mask squeeze showing subconjunctival haemorrhages and bruising and swelling below and above the eyes.

### Paul Langton

I have a case for which I want advice. I was sent a man, a very keen diver, who has been diving for 30 months by the local hyperbaric chamber after he had been treated for decompression illness. He has only done one decompression dive and that was an unplanned event when diving a wreck at about 35 m. He had not planned on doing a decompression dive but his buddy was inexperienced and towards the end of the dive disappeared back into the wreck. My patient did the responsible thing, went in, grabbed him and came out. He did the requisite decompression stop as shown by his computer. Some time afterwards he had marked impairment of concentration, inability to continue with his work, word confusion and number confusion. His only localising symptom was right facial numbness. The hyperbaric facility said that he had normal central and peripheral neurology. He did have problems with the minimal mental state. Although he scored 30 out of 30 he had great difficulty performing serial 7s and that impressed them because his work involved numbers. He also had some subjective problems with sentence recall. It was decided that he had neurological decompression illness. They treated him and he returned to normal. Because it was thought to be a relatively unprovoked episode they had a trans-thoracic echocardiogram done, which showed a patent foramen ovale. Their working diagnosis was arterial gas embolism and he was advised never to dive again.

Unfortunately he wants to continue diving and is not going to give up diving regardless of advice. He came to see me as he wanted medical clearance to do a Nitrox course to try and reduce the risk of such events in the future. He

had read all the literature and was very cognisant with most of the studies.

My questions are whether he had decompression illness, should he be able to dive again on the basis of those symptoms, and should he have the PFO closed?

**David Elliott**

Yes, Yes, Yes.

**Paul Langton**

Closure of PFO is something that we are going to start seeing. More and more patients are being referred because we have a special interest in the area. We get the cases of unexplained decompression illness from the local chamber and we have got the facility to use trans-catheter closure of PFOs with a new device. Peter Wilmshurst has reported a series of these cases but the thing about them was that they all had early onset, clear neurological symptom decompression illness which this man did not really have.<sup>8</sup> He had some difficulty doing serial 7s but he was able to work as a statistician without any clear impairment. I wonder if some of his symptomology may be related to anxiety or a near stress sort of trauma. But he has keen to have the PFO closed. We wanted to look into a little bit more about whether it may be relevant and there is one interesting paper from several years ago where a group had done a series of studies on divers without clear cause for their decompression illness. They had looked for a right to left shunt (suggesting a patent foramen ovale) with a trans-cranial Doppler technique. They did high resolution brain MRIs on all of them and found that there is a small group who have a high flow right to left shunt and are much more likely to have multiple "white lesions" on an MRI.<sup>9</sup> He is going to have a brain MRI. It is an extravagant investigation but it is aimed at trying to firm up the likelihood that his PFO has something to do with his clinical event. If he has a normal scan I think it is less likely that the PFO is related to his clinical events. If he has lots of multiple lesions, given his diving experience I think we are on stronger grounds for closing him but I would be interested in your comments.

**Simon Mitchell**

I think this gentleman definitely had decompression illness and moreover his symptoms were all in a sort of cerebral distribution. They could all be explained by a shower of bubbles to the cerebral circulation and so I think the fact that he has a patent foramen ovale probably should not be ignored. He clearly wants to dive again and I think that under those circumstances it would be justifiable to close his PFO. I appreciate your attempts to try and nail down the significance of his PFO but I think that at the end of the day, you are not going to be able to do that with any acceptable certainty and my advice would be to close it. So, it is yes, yes and yes, like David.

**David Elliott**

I had a close look at that paper and various others. Alf Brubakk found that most of the lesions were unidentified

white objects. A study in Bergen found that the control population, Bergen policemen, actually had more lesions than the divers.<sup>10</sup> Peter Rink, who runs the MRI unit in the University of Trondheim, says we have no standards of normalcy, even now, for MRI of brains. That paper you quoted is not generally accepted in our diving medicine literature because we just do not believe the MRI has any great clinical significance.

**Simon Mitchell**

I will not have to sign a piece of paper because no piece of paper is necessary for him to resume normal diving activity that he is already trained for and I think that makes it a little easier for me. With the exception that he wants to go off and do further training and get a new clearance, we may be able to find a way around that. What we have not really talked about is there are risks with closing a PFO and there is not enough experience of the procedure to know what those risks really are. It may be that his risk of future events is less than the risk of a closure procedure.

**David Elliott**

My concern is his mental function. He really needs to have a full neuro-psychometric study. I think he should be advised again not to dive, because of cognitive dysfunction. I would never ever sign a piece of paper for him. I would only agree to a closure if he was intending to ignore the advice he has been given that he should not dive at all.

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### FITNESS TO DIVE

Panel discussion with audience participation

**Chairman** Guy Williams

**Panel members** David Elliott (Guest Speaker), Robyn Walker, Des Gorman and Vanessa Haller

#### Key Words

Diving medicals, fitness to dive, medical conditions and problems, questionnaires, risk

#### Guy Williams (Chairman)

This is a summary session and perhaps we may be able to produce a policy statement or other statement on fitness to dive.

#### David Elliott

Hidden amongst all the information presented this week are one or two things which I consider to be important.

When it comes to reviewing fitness to dive, remember that instructors and dive guides are occupational divers and they require a different examination to that of recreational divers.

My concern with the idea of using informed consent to pass anybody who turns up, is what to do with the paranoid schizophrenic who wants to be your buddy.

I have no problem with solo divers. Nobody is going to find them anyway so putting the buddy at risk is not a problem.

Why are we so fanatical about health in diving when brain and equipment failure actually kill more people than pre-existing medical problems? It is because not just the diver is put at risk, there is the buddy and the others who may become involved in the rescue. It is true that some diving fatalities have been found at post mortem to have had medical problems, but these findings had no proven

relevance to the cause or mode of death. So let us not get too influenced by a history of asthma.

SPUMS is involved with recreational diving. It is important for the Society to consider the definitions of recreational diving. I consider that we should exclude rebreathers and mixed gases at this time. This equipment may be used for recreational purposes but its safe use requires considerable further training beyond the basic Open Water Diver. So we will focus on open circuit scuba using air or nitrox. Nitrox has depth limitations in order to avoid cerebral oxygen toxicity but can be used safely with attention to remaining above the danger depth. A lot of people dive to 60 m or so on air and experienced people might do it safely. I suggest that we call such diving "deep recreational diving". The idiots are those people who go to 80 or 90 m or even deeper ("extreme air diving"). Possible SPUMS definitions of recreational diving using open-circuit scuba are shown in Table 1.

**TABLE 1**

### RECREATIONAL SCUBA DIVING

Description	Breathing gas	Depth range
Normal	Air	Depth to 40 m
	Nitrox	Depth limited to PO <sub>2</sub> 1.4 bar
Deep Air	Air	Between 40 and 60 m
Extreme Air	Air	Below 60 m

Des Gorman has made some very important points about the validity of self-assessment forms and I think we really must take more notice of that. The most important medical anybody ever has is the one before they start diving. That is the one time we can stop candidates from diving and they can go and take up something else, probably just as happily.

The other important medical is the review required after some significant illness. Our medical intervention is needed there and it has to be done by a doctor who is competent. It can never be done by prescriptive rules.

I would like us to consider, if we have time, what to do with people who do not easily fit into the conventional recreational envelope. During the week we have considered that and decided that people, even if they are stable asthmatics, can be fit for independent unrestricted diving within the envelope under certain circumstances. If they are fit to dive, then they can do anything within that envelope.

Some people will have self-imposed shallow diving restrictions, such as those who have had a previous bend with probable scarring. They might like to dive on enriched



air nitrox (EAN<sub>x</sub>) or do something sensible like that. Or they may choose to for broke and not bother. That is entirely up to them. It is self-imposed and I think that those people should be able to dive at any conventional dive shop. They just stay above their personal set limit.

Then we come to the people in whom diving is definitely restricted and there are those who need some in-water support. They may not be able to help anybody else and they may need a second buddy. These include amputees, double amputees and particularly paraplegics. Diving quadriplegics are a good example of divers who are totally dependent on a support team. I would include the diabetic diver in the restricted category. They must have a support team that knows what is going on and what to do. The above is a precis of my formal presentations, goodbye and thank you for having me.

#### **Guy Williams (Chairman)**

I hope people will comment from the floor or from the panel. I think that as a result of the five days of meetings, most of us would agree that there is a need for fitness to dive assessment. Table 2 shows some of the choices. Should fitness be assessed by doctors with training in diving medicine? That is certainly SPUMS policy. Or should we just assess those identified by initial screening. That is certainly not SPUMS policy. Other matters to consider are reviewing divers after a diving incident and whether divers should be medically examined periodically.

**TABLE 2**

#### **FITNESS TO DIVE ASSESSMENTS**

- 1 PADI RSTC questionnaire or similar where certain responses lead to referral for a medical opinion.
- 2 Medical examination by any doctor.
- 3 Medical examination by a doctor trained in diving medicine. (SPUMS Policy)
- 4 Review after incidents by a doctor trained in diving medicine. (SPUMS Policy)
- 5 Periodic reviews are they value for money ?

#### **Kim Bannister, Auckland**

I am a GP. Should the candidate's GP or a doctor trained in diving medicine do the pre-diving assessments? Is a doctor who is trained in all aspects of what the hazards are for diving more important than the understanding of the patient that the regular GP brings? During the week there have been quite a few examples where screening by the RSTC form missed things. I have done the Navy course and I found that useful. However, I think it would be very hard for patients to pull the wool over their own doctor's eyes when they fill in the forms. When dealing with diabetics, epileptics and quite a number of other examples, knowledge of the patient might be useful. I wonder whether

assessment might be best done by a GP with the option to refer on to somebody trained in diving medicine.

#### **David Elliott**

In the UK a report from the GP may be requested by the examining doctor for candidate occupational divers.

#### **John Knight, Melbourne**

After much effort, I persuaded the Australian Medical Association, which believes that doctors should act ethically, that it is unethical for a doctor with no knowledge of diving medicine and no training in how to examine divers, to do a diving medical. Now I do not know what the NZ Medical Association's attitude to ethics is, but the Australian/New Zealand Standards Committee SF17, of which I am now the Chairman, believes that it is ethical and essential that any diving medical should be done by a doctor with training in underwater medicine. I do not think we should agree that we should only assess those identified by screening. We should assess every person who is going to use compressed air, or any other breathing medium, under water. It is the first dive that really matters.

#### **David Elliott**

Medical services differ around the world. In countries where there are no diving doctors, we should acknowledge that the RSTC form and other questionnaires have improved the situation and there is a benefit from them. But in countries where there are diving doctors such as Australia, New Zealand and much of Europe then I think we can be a little bit more rigorous.

#### **Des Gorman**

Dr Bannister has the advantage of being both the family doctor of the patients who see him for their diving medicals and having had training during the Naval course. Our audit suggests, without doubt, that there is a significant difference between the quality of assessment done by the trained and the untrained doctor. It is quite right that the GP is the only person who actually knows comprehensively what is wrong with that patient. But there are other pressures such as patient retention, patient compliance and other issues which make for very complex outcomes. That is certainly true in Worker's Compensation issues. It is not quite as simple as the GP knows more about that patient than somebody else. What David Elliott has just described, where there is a report from the GP and the assessment is done by a trained doctor, is a bet both ways. That is an approach which would, I suspect, satisfy your concerns.

#### **Michael Logan, Dubbo**

I am on the SPUMS diving doctors list and I live in Dubbo which is 400 kms inland. Port Macquarie Divers come to Dubbo and train people in the local swimming pool and then take them over to the coast for their open water dives on one weekend. A lot of GPs are now conscious of diving requirements but there are many doctors who have got no concept about diving at all. For them to give

somebody an OK to go diving is quite ridiculous. The last two people who came to see me for a diving medical had gone to their local doctor who said, "Oh, you play football do you?" and he said "Yes". The doctor then said "You're fit to dive". When the patient rang up Port Macquarie Divers the instructor said "Probably you should see somebody who knows more about diving than somebody who said that because you play football you will be fit to dive".

#### **Guy Williams (Chairman)**

I think most of us would probably agree then that fitness to dive should be assessed, in an ideal world, by a doctor with training in diving medicine, and that has been the SPUMS policy for some time.

#### **Drew Richardson, PADI**

Are we suggesting primary assessment by a physician with diving medicine training when we have, during the week, seen that New Zealand and the United Kingdom, even with a medical referee, are going to questionnaires? The RSTC system has been in use for nearly 11 years with 8 million assessments. I do not really see the problem we are trying to solve. PADI believes that a well developed screening (RSTC) test, as a primary assessment, works and has worked for some time. With this, when a client ticks an affirmative, he or she is told see a medico with some diving medicine expertise.

Are we suggesting that this Society should recommend that all candidates, whether it be a resort try dive or diver training certification, should go to a diving doctor before they take a breath off scuba?

#### **Guy Williams (Chairman)**

Am I right, Des, that your paper about the NZ system was about review surveillance and that all your commercial divers had their first medical by a diving doctor?<sup>1</sup>

#### **Des Gorman**

That is the system at the moment. We are now testing the predictive power of the fifth yearly medicals and I am going to test the predictive power of the initial assessment as well. In terms of screening, we will wait and see how effective our screening tool is, but Drew makes a point which needs to be addressed which is that they have had a screening tool in place for 11 years, so there is a performance record in place. I think the reason why it works Drew is most of the assessments for fitness for diving has got little to do with doctors.

#### **Unknown speaker**

I think that doctor assessment and re-assessment have a role in the occupational field. For recreational diving in its increasingly diverse forms we know that there are few fatal incidents with acknowledged medical precursors. We know that people are either opting in or opting out of the medical examination system worldwide and we do not have evidence that suggests any relative advantages. We know

that if there is not a local doctor then it probably really does not make much difference. When do we reach the point that it really is worthwhile?

#### **Des Gorman**

There needs to be a system to weed out those who may come to harm. The more important thing is that the doctor involved be trained in diving medicine. As we move to a more mature approach to health surveillance and as we put more emphasis on individuals, including the dive schools and employers, taking responsibility, the need for a trained doctor becomes a significantly more important. There is only one role for an untrained doctor, and that is if one can write a prescription for fitness. There is no such prescription for fitness. It is a nonsense. I think the need for training for doctors increases under the scheme that I described to you. It does not decrease, because what it is all about is quality of risk information.

#### **Drew Richardson, PADI**

I think you may have missed the point I was trying to make. I am not denying the need for the trained doctor and the very important role for the trained doctor in assessing conditions that have been raised by the questionnaire. However the debate seems to be focussed on whether every recreational diver should see a trained doctor for an assessment before being allowed to get in the water. I do not think that attitude has much validity because of what is going on around the world.

#### **Des Gorman**

To be honest I do not see the difference. We had a debate in Auckland with the Department of Labour and some of the recreational diving organisations about stratifying standards for diving fitness which I think is nonsense.

It is risk that is stratified. For example we have heard that some abalone divers now wear a full face mask, have hard wire communications, a bail out bottle, two divers and two stand-by people in the boat.

In more conventional occupational diving I am on the bottom wearing boots. I have a bail out bottle, a helmet, a side block, an emergency gas supply, an umbilical bringing down breathing gas, communications and warm water. As well, I have a diver dressed and on stand-by to rescue me. I have someone controlling the divers, a supervisor. I am cutting, drilling or blasting. I have a known level of risk.

Let us now take the recreational diving instructor who is free swimming with 4 or 5 novices. Which of those two divers has the greatest need for sustained awareness? The occupational diver, whose private risk is one and public risk zero, and for whom there are all sorts of support contingencies in place. Or the free swimming recreational diving instructor. If one is going to stratify risk the free swimming recreational diving instructor has a greater need for help, not a lesser need. There is need for good advice

about occupation. In this context occupation is something someone does, not necessarily for money. The minute we exchange money, a duty of care is imposed by legislation, but the need for risk decision making is no different. In my opinion, a free swimming, unbuddied, which is what you have if you are not holding hands or using a buddy line, diver has a very real need for substantive health advice. So I do not draw the sorts of distinctions other people make.

#### **Henrik Staunstrup, Denmark**

Taking a world wide view we can see areas where the screening method is absolutely essential as there are no diving doctors around. Assessment of fitness to dive by doctors who are trained in diving medicine is only available in certain areas. It is true that RTSC form has worked well but it has not been used all over the world and medical assessment has worked well in areas of the world.

The system Des has introduced in New Zealand is for divers who all had a medical before they started diving and it is for occupational divers. The employers are really very interested that their divers are in good health. I see it quite differently with recreation divers and I can only agree with David Elliott that we have two situations in the world and what we should recommend is a really good standard. We have to serve the community well with doctors who are trained in diving medicine. Then where this is not possible self assessment is OK for me. If you have a better way, why not use it?

#### **David Elliott**

Perhaps the better way is to follow the UK where there is a combination of two philosophies. They are using a screen which does not involve doctors for about 90 odd percent of divers. When there are affirmative answers the diver goes to see a medical referee, who is trained in diving medicine. That model is perhaps a more pragmatic and efficient system if you want to make a statement that would work around the world.

#### **Paul Langton, Perth**

I want to challenge the assumption that the PADI type questionnaire works and it has been useful for years. We do not actually know that and I would argue that we have got some data to say that it does not work. Also I do not think the dive medical necessarily works, because we know that diver candidates are not always truthful. Both methods assume a level of honesty. If we are going to change the system either way and focus on risk assessment using a screening questionnaire, it must be with the clear understanding that if the candidate ticks a "Yes" they will not be automatically knocked out. It must be made clear that they just need further risk assessment. Otherwise they will continue to lie and say "No". As we know that in Western Australia 90% of diving candidates are getting dive medicals anyhow, even having done the PADI questionnaire we probably should support a statement like, "Ideally diving candidates should be assessed by a doctor trained in diving

medicine". This may be more practical than saying they must be assessed by a doctor trained in diving medicine.

#### **Cathy Meehan, Cairns**

I agree with Paul. The medical screening form is a very good option when there is nothing else available. However on many occasions when face to face and asked questions, people actually do admit that they have had some problems that they had not ticked.

#### **Guy Williams (Chairman)**

I think that SPUMS should be aiming for best practice and, in my opinion, best practice is to have diving medical candidates examined by a doctor with training in diving medicine. It might not always be appropriate but I think that best practice is what this Society has been endeavouring to promote for some time. It is certainly what we endeavour to do with the SPUMS diving medical, which was distributed to you all, and that states that it should be performed by a doctor with training in diving medicine.

#### **Jürg Wendling, Switzerland**

I consider that the primary assessment is done by a doctor. One of the most important questions is the motivation of the candidate. On many occasions I have had a candidate who has said "My husband wants me to dive with him but I am very frightened of diving." So there are occasions where I discourage diving, without even examining the person. There are many similar occasions. They have had an incident. They do not say it. It's not one of the questions in the questionnaire and it is our task to help these people get away from diving.

#### **Mike Davis, Christchurch**

Worldwide the screening form is clearly the way the majority of people get into sport diving. One of the issues that has been raised is that where screening questionnaires are used in health assessment, that screening is enhanced if the candidate is taken through the questionnaire by somebody who has some knowledge in the area. Perhaps visiting your GP's rooms but going through the questionnaire with his nurse might be better than nothing. But in most situations around the world, the most knowledgeable person around the intended sport diving candidate is the dive instructor. I have often wondered why it is that the dive instructor who is going to look after the pupil, or someone from the shop who has some education in diving medical problems from his own training, does not go through those questions over a 5 or 10 minute period with the candidate. I am suggesting someone who can explain the questions that the diving candidate does not understand. That might well enhance the quality of the screening process without necessarily placing an additional legal onus on the dive instructor.

#### **Des Gorman**

We should put things in perspective. There are very few beaches in the world where dead divers are washed

ashore on a regular basis. The mortality from diving is exceptionally low. We have had a very bad year in New Zealand. Deaths were about one in 50,000 exposures which is still a lot better than driving on the roads. The risk of decompression in Western Australia given the best data we have, is probably one in every 7,500 hours of exposure which again is better than driving on the roads.

What I am arguing for is assessment of risk. Assessment which improves the quality of people's decision making to undertake a particular activity. Never forget that divers die because of human error, 99 times out of 100. They do not die because of health problems. They die because they make dumb decisions and usually several of them in sequence. They are dumb, they die because they go where they should not go diving. They dive in conditions where they should have made a decision about their own health in terms of ability to undertake a particular dive. That is not a health problem in my opinion. That is a decision making problem. That is human error and is that surprising?

In every industry I have ever studied, 95+ percent of accidents and incidents are due to human error, not equipment failure and not to human body failure. The point is that, in terms of screening procedures, there are some data that suggest that whatever we are doing may be making no difference at all. In fact the human health factors are dwarfed by the human error factors. We cannot create a system which will either halve or double deaths. We are on the flat part of the curve for most recreational divers in terms of risk exposure and shifting backwards and forwards really does not make any difference. The important thing is to make sure that people decide to do something with sufficient information to make an informed decision. That is what it is all about as far as I am concerned. I know the major cause of deaths in diving is human error in New Zealand and around the world. Diving deaths are very rarely predominantly due to health problems.

#### **Deborah Yates, Sydney**

It seems to me that there is an extremely good screening system and you have an excellent training system but what you are missing is education. The point that has just been made, that the majority of problems come from human error, demonstrates the fact that the difficulty is that people do not understand the risks they take. That is really the huge problem that occurs with the recreational divers.

I suggest that we move on to considering what sort of manoeuvres can be put in place for enhancing understanding. Not only of risk in diving but of reminding people about what are the appropriate things. And when I say people, I do not just mean recreational divers. I include all medical practitioners, so that the awareness overall of the medical aspects of diving is enhanced. It is very true that people who are not regularly involved in diving are not appreciative of the risks involved. I think the Society would probably do well by producing some educational videos

which can be made available to the Colleges and placed on the SPUMS and other websites. I think that, on the whole, you have got a very good system already in place and you do not need to complicate it much more. It is already much better than for most sports.

#### **Guy Williams (Chairman)**

David Elliott mentioned the concept of reviewing fitness status. At the moment in Australia the situation is that once you have been certified fit at the beginning of training the only time you are likely to have another diving medical is when you are doing some more advanced course and it has been more than a certain time since your last medical. If you have been certified for a couple of years and want to do a cave diving course, you are likely to be required to have another diving medical .

But for people who have not done further courses, their last diving medical may have been when they started and that might have been 25 years ago. David suggested that perhaps after the age of 45 people should be reviewed every 5 years and after 60 every year. Perhaps it may not be a bad idea for the certifying agencies, who have records of divers to be, to send out, when the diver hits say 45, a health screening form.

#### **David Elliott**

I think if you make periodic surveys cheap enough then you could make them no longer an issue. The reason why recreational divers do not have an annual medical is because it is expensive. Make it cheap. Put in place a system which is easily accessible then I am sure many people would take advantage of that and have their health surveyed.

#### **Chairman (Guy Williams)**

Robyn Walker, as President and official spokesperson for SPUMS, should we be recommending that fitness status be reviewed? At the moment we do not recommend this.

#### **Robyn Walker**

We know that some divers will lie on their questionnaires or their screening questionnaires. That is not my problem. It is that individual's problem. We should be screening or discussing diving issues with every diver who comes to see us. We should be encouraging people to do that and we should encourage people whether they are pregnant, whether they develop some inter-current health condition, whether they are just aging to discuss their diving with us. I am more than happy to discuss issues with anybody who has an interest to listen.

But it is not our role to be police. I think we should be recommending that people have their fitness to dive reviewed from time to time but it should include their general health. We can recommend but we can do no more.

#### **Bill Brogan, Perth.**

I think David Elliott hit the mark in his first lecture

when he said “Are we in the business of regulating and why should this sport be regulated by doctors rather than any other sport?” I think Des reinforced that in saying that human error is the main cause of diving accidents. Not always human error of the diver. Sometimes the dive master makes an error. Sometimes the training organisations make the error. The last two people to die in the water in Western Australia, had, or were alleged to have, advanced open water diving certificates. To achieve this higher qualification one had done 9 dives in all and the other 11 dives. That to me is insane. To let anybody proceed to higher training before they have done at least 50 dives is crazy. I think guidelines to prevent these sort of accidents should be given by SPUMS.

#### **David Elliott**

One of the best documents is the Project Stickybeak report of 300 consecutive fatalities and if you look at the first year and you look at the final year, 20 years later, there is still no change over those 20 years.<sup>2</sup> The deaths are more than 50% stupidity, they were diving beyond their competence. That is what needs to be hit and the difficulty with your suggestion is the need to change the training provided by the training agencies.

#### **Guy Williams (Chairman)**

We should be offering advice. We are in the business of providing the best risk assessment for people and we should be doing that. But it is not our responsibility to say what makes an “advanced diver”. We made a rod for our own backs years ago by saying that a person is “fit to dive”.

Now when there is an accident, blame is often directed back to the medical practitioner. We do not have to accept that. What we now tell the person this is the risk if you go diving. And then they accept the risk and it is up to the training agency to accept that risk. That is where we are heading. We are not in the business of telling people what makes an advanced diver. There are some people who will never be an advanced diver, but that is not our role.

#### **Henrik Staunstrup, Denmark**

In Denmark we tell divers about the risks. We are not policemen. We do not regulate how people dive. I never tell prospective divers yes or no, but I explain the risks and I think I know better than an instructor. I feel that diving doctors are the best to inform divers about the risks and for that reason I think divers should be seen by diving doctors whenever possible.

#### **Guy Williams (Chairman)**

The current SPUMS policy is that insulin dependent and those diabetics on oral hypoglycaemic agents are unfit for scuba diving, even though we all know that plenty of them are diving. Drs Taylor and Mitchell discussed diabetics diving earlier in the week. Has anyone any comments on diabetes and diving? It is likely that SPUMS will to be asked by the Diabetic Association for an opinion on diabetics and diving.

#### **Des Gorman**

Considering the data reviewed one has to be careful of selection bias. Self selected, self reporting data bases are generally biased by the healthy diver effect so one has to be careful of survival bias. As a result I have no confidence in the diabetic data that I see, and that is particularly true for the BSAC data which is a self selected, self identified, survivor population. One cannot extrapolate from that community in any shape or form.

To me the idea that we cannot express an opinion about insulin dependent diabetes in general is like arguing the need for randomised control prospective study of expired air resuscitation and the apnoeic. There are some things which you do not necessarily need to put to that level of test because they are reasonably obvious. The fact is that an insulin dependent diabetic should be advised strongly about the risks of insulin dependent diabetes and diving. As an instructor I certainly would not teach one of them to dive, although I am not an instructor. As an employer I would go to the disability court and say listen, this person has unreliable awareness and state of consciousness. I am not going to employ them. I reckon I would survive that test to be honest. So I am not sure that the data are available. They show that a population of diabetics can dive, and that is all they show.

#### **Simon Mitchell, Brisbane**

Diving for diabetics is a handicapped diving procedure.

#### **Jürg Wendling, Switzerland**

As I explained during my presentation, I would let diabetics dive under certain conditions. But I would only let them dive in a diabetic diver program which continues after training to cover all their diving. I think they need a doctor as adviser during all their diving career.

#### **Simon Mitchell, Brisbane**

The data from Chris Edge’s study, which was a prospectively followed group of diabetics, do show that focussed, well trained, and properly supported diabetics can dive. And that is precisely the sort of program that we are proposing we teach.

#### **Alan Walley, Christmas Island**

I certainly will not be getting involved in teaching diabetics to dive. Many of us in isolated places do not want a bar of that. I think we would like to have crystal clear guidelines so that when people go in the water we can be fairly sure that they will come out of the water. Associated with special programs for diabetic divers I can visualise a headline in the Medical Journal of Australia saying that diabetics can dive. All the Mickey Mouse doctors would see the headline but they would not read the article. We might create a problem of the poorly controlled diabetics who want to dive on a good day. I think we have just got to be very careful.

**Cathy Meehan, Cairns.**

The SPUMS dive medical and the Australian Standard say that corrected vision has to be adequate to look at your gauges and to be able to surface and see your boat. Yet blind people dive very successfully. There are other situations where people with medical conditions and physical problems can dive, as long as all the necessary precautions are taken into consideration. These people are not fit for diving according to AS4005.1. They need to be diving according to very strict guidelines set out by the International Association of Handicapped Divers, or some other Association, that is set up to provide guidelines for safe diving for such people.

**Simon Mitchell, Brisbane**

I would like to remind you all that we were clearly not saying that diabetics will be able to go and get a medical to dive and just go down to their local dive shop and sign up. Not many instructors would have an interest in becoming a specialty diabetic diver instructor and it may be that we would not consider some instructors qualified to do it. We were quite specific that the instructors would need to be selected, the diabetics would need to be selected, the courses would be very carefully structured. Until there is a simultaneous recognition that this can happen, from both the training agencies and the medical community, it will not be able to be done properly. It does need to be done properly. You are absolutely right about that.

**Robyn Walker**

At the beginning of this week I said we hoped that there would be interesting discussion. I think that tonight we have proved that we are going to have continued debate for many years to come over how we practice diving medicine. We all have to be responsible for the way we practice and if we practice within the limits of our knowledge and are able to defend our actions, then we are always going to survive whatever challenges come.

In closing I would like to thank David Elliott, our guest speaker, and all the other speakers for what has been an excellent meeting.

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## ARTICLES OF INTEREST REPRINTED FROM OTHER JOURNALS

### MEDICAL SUPERVISION OF SPORT DIVING IN SCOTLAND: REASSESSING THE NEED FOR ROUTINE MEDICAL EXAMINATIONS

Stephen Glen, Steven White and James Douglas

#### Key Words

Diving medicals, fitness to dive, recreational diving.

#### Abstract

##### *Background*

The value of diving medicals in preventing incidents is uncertain and there has been only limited evaluation of the fitness to dive guidelines in a sport diving population.

##### *Objective*

To examine the need for routine diving medical examinations in the Scottish Sub-Aqua Club (SSAC) between 1991 and 1998.

##### *Methods*

A medical examination of all SSAC divers is performed at entry and then every one to five years based on their age and medical condition. This information was analysed in terms of questionnaire findings and examination abnormalities.

##### *Results*

There were 2,962 medical forms available for analysis. Examination abnormalities were found in 174 subjects (5.9% of the population), with obesity affecting 75 subjects (2.5%). There was a linear increase in mean body mass index ( $r^2 = 0.92$ ), and a significant difference between 1991 and 1998 (mean ( $\pm$  SD) of 24.1 ( $\pm$  3.07) and 25.02 ( $\pm$  3.4) respectively,  $p = 0.002$ ) which was not related to age or sex distribution. There was also a significant increase in the prevalence of smokers ( $\chi^2 = 4.02$ ,  $p = 0.045$ ). The most common specialist referral was for evaluation of asthma, with hypertension and obesity as the next most common reasons. Most subjects were allowed to dive, with only 43 (25%) being failed outright. Overall, no examination abnormality alone caused a subject to be classified unfit to dive, and referrals were prompted by the answers in the questionnaire.

##### *Conclusions*

No significant unexpected abnormalities were found on clinical examination in this population of sport divers. Conditions that prevented subjects from diving were detected by the questionnaire, and this prompted referral for further assessment by the medical advisers. Routine medical examinations were of little value.

(*Brit J Sports Med* 2000; 34: 375-378)

#### Introduction

Sub-aqua diving is a popular sport in the United Kingdom involving almost 100,000 amateur divers in 1998.

As with any sport, specific risks are involved,<sup>1</sup> but serious injury is rare,<sup>2,3</sup> reflecting the high standard of training provided by the diving organisations. They rely on medical support to identify preexisting conditions that may increase the risk of incidents. The main medical risks of diving in the United Kingdom are conditions causing increased susceptibility to decompression illness, or unexpected incapacity that is likely to be hazardous underwater. For example, epileptics requiring medication or diabetics with recent hypoglycaemia are advised not to dive because of the risk of unexpected loss of consciousness which could be fatal underwater.

Diving incidents are usually the result of a sequence of events and it is important to eliminate medical conditions as part of this chain. There are detailed guidelines on medical fitness to dive,<sup>4-6</sup> although many of these are based more on physiological theory than convincing scientific evidence, as no randomised controlled trials have been performed. It would not be possible to perform such studies for ethical reasons, for example allowing uncontrolled epileptics to dive. The aim of the guidelines is to minimise the risk of an incident without excluding too many people who are keen to take up the sport.

Divers belonging to three of the main United Kingdom organisations, the British Sub-Aqua Club (BSAC), Scottish Sub-Aqua Club (SSAC), and Sub-Aqua Association (SAA), are currently screened using a questionnaire and a standardised medical examination by any qualified doctor. Most medical examinations are performed by general practitioners, and, if there is concern about a subject's fitness to dive, then an expert opinion is sought from a medical referee with diving medicine experience. The medical advice for these organisations is based on collaboration of the medical advisers forming the UK sport diving medical committee and conducted by over 60 approved medical referees across Britain. Other diving organisations use a self administered questionnaire for medical assessment of divers, with medical examinations performed only if necessary. This saves the expense of a routine medical examination, and there is pressure from divers to consider removing the need for this in the United Kingdom.

It is important to distinguish amateur sport divers from commercial divers who undergo a detailed medical examination at regular intervals as required by the Health and Safety Executive. Employers may be liable for the health of their divers whereas sport divers make an informed decision to participate in an activity with known risk. However, their ability to respond in an emergency, for example, to rescue a diving partner, is an essential requirement, and this is one of the most important criteria when assessing fitness to dive. If this ability is impaired, then either the subject should not dive or additional support

must be made available. For example, some disabled divers require two experienced diving partners to help cope with restricted mobility.

The value of diving medicals in preventing incidents is uncertain, and there has been only limited evaluation of the fitness to dive guidelines in a sport diving population. The aim of this study is to examine the need for routine diving medical examinations in the SSAC population.

**Methods**

All SSAC divers have a medical examination at entry and then every one to five years based on their age and medical condition. Medicals are required every five years below the age of 40, every three years between 40 and 50, and annually over the age of 50. This information has been stored centrally since 1991 and forms the basis of the analysis described below.

**Analysis**

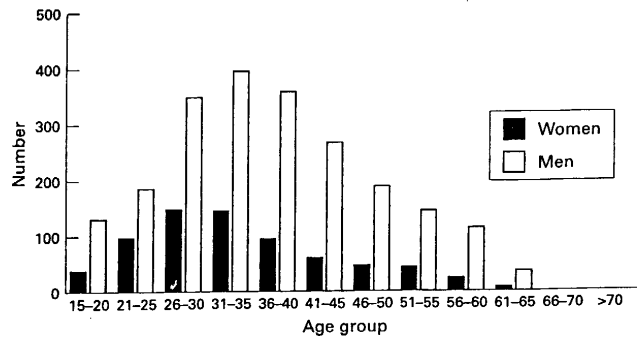
The database was anonymised and transferred to a spreadsheet for statistical analysis. This is mainly descriptive, including distribution graphs and frequency tables. Free text responses were categorised, for example into classes of drugs or disease types. Obesity was defined as a body mass index greater than 30 (defined as weight in kg divided by height in m<sup>2</sup>) and hypertension as a systolic blood pressure greater than 160 mm Hg or a diastolic pressure greater than 90 mm Hg. Percentages are of the total population analysed. Statistical analysis was performed using SPSS for Windows (version 9.0) using t tests for comparison of means between groups with normal distributions, and  $\chi^2$  for non-parametric comparisons.

**Results**

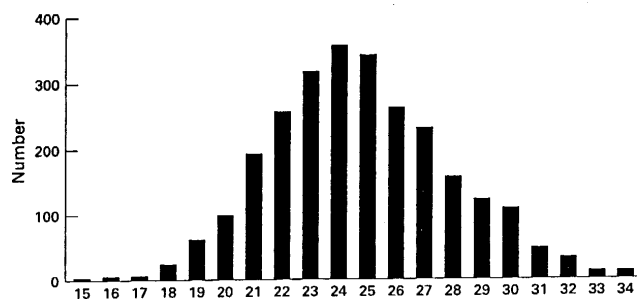
There were 2,962 medical forms available for analysis, of which 868 were repeat examinations. Figures 1 and 2 show basic demographic information.

The response to the self administered questionnaire is shown in Table 1 (page 177) which lists positive answers to each of the questions. Table 2 gives the reasons for previous hospital admission for 627 divers (21.2%). Medication was taken regularly by 112 (3.8%) divers (Table 3 page 177). Although only 59 subjects reported taking medication, some were using multiple preparations and therefore 127 drug types were recorded.

Table 4 (page 177) shows the examination findings. Blood pressure information was available for 1,148 examinations because this only became a requirement of the medical examination in 1995. Examination



**Figure 1.** Age/sex distribution for the Scottish Sub-Aqua Club (SSAC) population (total 2,962 divers).



**Figure 2.** Body mass index (BMI) distribution for the Scottish Sub-Aqua Club (SSAC) population (total 2,962 divers). Obesity is defined as an index greater than 30.

**TABLE 2**

**REASONS FOR HOSPITAL ADMISSION IN 2,962 DIVERS**

Reason for admission	n	%
Ear, nose or throat	112	3.8
Trauma	112	3.8
Appendix or hernia surgery	86	2.9
Orthopaedic surgery	66	2.2
Gynaecology or urology	62	2.1
Gastrointestinal	39	1.3
Respiratory	38	1.3
Skin	19	0.6
Dental surgery	16	0.5
Childbirth	13	0.4
Ophthalmic surgery	12	0.4
Endocrine (including diabetes)	12	0.4
Unspecified surgery	11	0.4
Varicose veins	10	0.3
Psychiatric illness	7	0.2
Neurology	6	0.2
Other	6	0.2
<b>Total</b>	<b>627</b>	<b>21.2</b>



**TABLE 1**

**POSITIVE RESPONSES TO THE SELF ADMINISTERED QUESTIONNAIRE (THE UK SPORT DIVING MEDICAL FORM BASED ON THE ORIGINAL WORK OF THE BSAC MEDICAL COMMITTEE AND JOINTLY PUBLISHED BY SSAC, SAA AND BSAC) IN 2,962 SSAC DIVERS**

Questions	n	%
1 Have you ever attended or been admitted to hospital?	627	21.2
2 Are you diabetic?	11	0.3
3 Do you wear dentures?	261	8.8
4 Do you regularly or frequently take any medication or other treatment with or without prescription?	59	2.0
5 Have you ever had any form of decompression sickness?	2	0.1
6 Are you currently receiving medical care, or have you consulted the doctor in the past year?	908	31.0
7 Have you ever been refused a diving medical certificate or life insurance or been offered special terms?	13	0.4
8 Has there been any change in your physical or mental health since your last medical?	23	0.8
9 Do you smoke?	351	11.9
10 Have you ever suffered at any time from any of the following:		
(a) Ear trouble, earache, discharge or deafness?	355	12.0
(b) Sinus trouble?	197	6.7
(c) Chest disease, including asthma, bronchitis or TB, pneumothorax, collapsed lung or exposure to dust?	220	7.4
(d) Attacks of giddiness, blackouts and fainting?	35	1.2
(e) Fits or any nervous disorders, including persistent headaches or concussion?	34	1.1
(f) Anxiety, "nerves", nervous breakdown?	27	0.9
(g) Diseases of the heart and circulation, including high blood pressure, chest pains and palpitation?	36	1.2
<b>Totals</b>	<b>3,159</b>	<b>107.0</b>

**TABLE 3**

**REGULAR MEDICATION TAKEN BY THE DIVERS**

**TABLE 4**

**EXAMINATION ABNORMALITIES**

Medication	n	%	Condition	n	%
Oral contraceptive pill	31	1.1	Obesity	75	2.5
Antihistamines	15	0.5	Ear, nose or throat	26	0.9
Antibiotics	15	0.5	Cardiovascular	20	0.7
Asthma inhalers	14	0.5	Musculoskeletal	12	0.4
Analgesia	7	0.2	Teeth	9	0.3
Antacid therapy	7	0.2	Eyes	7	0.2
Skin preparation	5	0.2	Skin	6	0.2
Thyroxine	5	0.2	Hypertension	5	0.2
Insulin	4	0.1	Neurological	5	0.2
Miscellaneous	24	0.8	Respiratory	3	0.1
<b>Total</b>	<b>127</b>	<b>4.3</b>	Abdominal mass	3	0.1
			Other	3	0.1
			<b>Total</b>	<b>174</b>	<b>5.9</b>

abnormalities were found in 174 subjects (5.9% of the population); the most common was obesity, affecting 75 subjects (2.5%). Although 20 subjects had detectable

**TABLE 5**  
**REFERRALS FOR SPECIALIST OPINION**

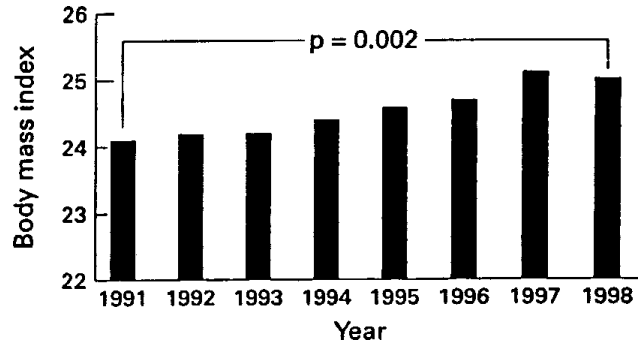
Condition	Number	% of referrals
Respiratory	52	30.2
Cardiovascular	22	12.8
Obesity	15	8.7
Diabetes, requiring insulin	14	8.1
Medication	12	7.0
Ear, nose or throat	10	5.8
Neurological	8	4.7
Epilepsy	7	4.1
Various	7	4.1
Previous decompression sickness	6	3.5
Musculoskeletal	5	2.9
General query	4	2.3
Leukaemia or lymphoma	4	2.3
Head injury	4	2.3
Psychiatric	2	1.1
Failed outright	43	25.0
<b>Total</b>	<b>172</b>	<b>100.0</b>

murmurs, none was found to be clinically significant after clinical assessment or investigation by echocardiography. Only two subjects were known to have murmurs before the medical. The neurological abnormalities listed were the result of previous illness and were therefore identified by the questionnaire.

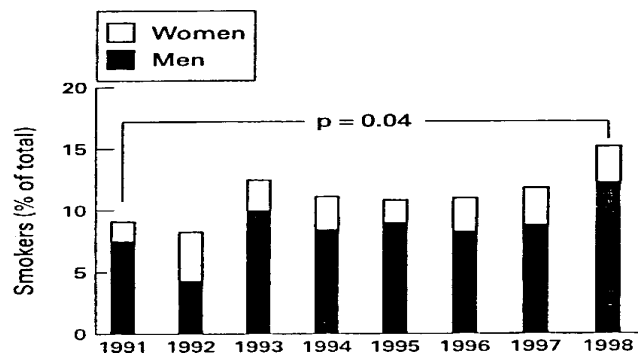
Table 5 lists the cases formally referred in writing to the SSAC medical advisers during the study period. The most common referral was for evaluation of asthma, with hypertension and obesity as the next most common reasons. Most subjects were allowed to dive, with only 43 (25%) being failed outright. Referrals were also received by telephone, and in many cases the problems could be resolved immediately without requiring formal assessment. Most of these cases have not been included in table 5.

Figure 3 shows the gradual increase in body mass index in the SSAC population; it is not related to any other change in the population, including age or sex distribution. There was a linear increase with time ( $r^2 = 0.92$ ,  $r = 0.96$ ) and a highly significant difference between 1991 and 1998 (mean  $24.1 (\pm 3.07)$  and  $25.02 (\pm 3.4)$  respectively,  $p = 0.002$ ).

Figure 4 shows the prevalence of smokers; there was a significant increase between 1991 and 1998 ( $\chi^2 = 4.02$ ,  $p = 0.045$ ). This increase is not restricted to any particular subgroup, for example young women, and reflects a general trend.



**Figure 3.** Gradual rise in body mass index over time, with a highly significant difference between 1991 and 1998.



**Figure 4.** Prevalence of smokers over time, with the proportion of women remaining constant despite a significant overall increase from 1991 to 1998.

Overall, no examination abnormality alone caused a subject to be classified unfit to dive and referrals were prompted by the answers in the questionnaire.

**Discussion**

It is reassuring that no significant unexpected abnormalities were found on clinical examination in this population of sport divers. Conditions that prevented subjects from diving were detected by the questionnaire, and this prompted referral for further assessment by the medical advisers. The current system therefore has been very effective in the SSAC but relatively inefficient and expensive for the divers.

It is disappointing to see the gradual increase in body mass index and also the resurgence of smoking, particularly in the last year. Health promotion is an important part of any sport, particularly in sub-aqua diving where the risks can be substantial. The increase in weight is not a secondary finding related to age or sex characteristics of the divers and probably reflects a lifestyle problem for the Scottish population in general. A high body mass index is no longer a contraindication to diving, and obese divers are assessed in terms of their ability to complete physical tasks during training.

The questionnaire is usually completed in isolation by the diver, although in a small number of cases the examining doctor completes the form. This raises an important point about whether some divers conceal information that is relevant to their fitness to dive and any new system must take account of this. The form is a legal declaration, and if a diver is found to have been fraudulent in its completion, then his/her insurance is not valid. Divers are encouraged during training to take responsibility for their own safety and that of their diving partner. It is also appropriate that they monitor the development of symptoms or signs relevant to their fitness to dive. With guidance from a well designed questionnaire, this is feasible and much more economic than routine medical examinations of the whole diving population. It will then be possible to direct the medical supervision of divers more efficiently to those who require specialist support. This will have important commercial implications for the three organisations, and the United Kingdom sport diving medical committee is developing a new form to eliminate routine medical examination except for subjects estimated to be at high risk. The new questionnaire and the definitions of high risk subject groups will be based partly on this database, although regular surveillance of diving incidents and feedback from the organisations involved will be required to ensure safety.

### Conflict of interest

SG is the Medical Adviser of the SSAC and Secretary of the UK Sport Diving Medical Committee (UKSDMC). JD is the previous Medical Adviser of the SSAC. The views represented are those of the authors and do not necessarily reflect SSAC policy or UKSDMC consensus.

### Take home message

Diving is a safe sport requiring medical supervision, but routine clinical examination of all divers is unlikely to detect significant abnormalities relevant to their fitness to dive. A carefully designed questionnaire will allow most relevant conditions to be identified and save unnecessary expense for both divers and doctors.

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## PROBLEMS WITH MEDICALS STEER CLUBS TOWARDS SELF-ASSESSMENT

Paul Fenner

### Key Words

Diving medicals, questionnaire

The present system of diving club medicals by which members have to be examined by a GP or listed diving medical referee before being certified to dive and re-examined at intervals, could be dropped in favour of a self-assessment scheme, if a proposal put forward by diving doctors is accepted. The move will, doctors argue, provide a more efficient examination service. It would also save divers the cost of examination until a specific area of concern arises.

Divers would fill in a revised UK Sport Diving Medical Form containing a questionnaire specifically designed to establish the existence of any symptoms that could indicate conditions affecting fitness to dive. Positive answers would lead to contacting one of a list of recommended diving medical referees (100 or so doctors around the country, with knowledge of diving physiology and medicine) for consultation or referral to a specialist. In determining whether physiological problems exist, the medical questionnaire asks, among other things whether members have suffered from high blood pressure, angina, chest pains or palpitations, blackouts, fainting or dizziness, collapsed lung or pneumothorax, lung disease, asthma, epilepsy, diabetes, headaches, nervous system ailments including strokes and multiple sclerosis, back or spinal surgery, alcohol or drug abuse and current medication, including the contraceptive pill.

The system has been devised by the nine doctors who make up the UK Sport Diving Medical Committee (SDMC). Information packs have been sent to branches of the British Sub-Aqua Club, Sub-Aqua Association and Scottish Sub-Aqua Club, all of which would adopt the scheme. As *DIVER* went to press, responses to the proposal were being invited.

Results of opinions will be released in early May and, if the scheme proves popular, its acceptance by the clubs would be imminent. It would also be made available to divers who do not belong to any organisation. The move would bring clubs closer to PADI, which provides divers with a Recreational Scuba Training Council Medical Form containing a questionnaire. Any affirmative replies mean that the client needs to obtain medical clearance for diving.

The club scheme is based on a broad study by Dr Stephen Glen, a member of the UK SDMC. Working with colleagues at Edinburgh University, Dr Glen examined records of the existing system alongside a pilot study of the proposed system. with the help of around 3,000 members

of the SSAC. They concluded that the questionnaire part of the proposed form was "the most useful way of screening members to see if further assessment was required. The routine medical examination added little and SSAC members, whose answers to the questionnaire identified problems, could then be seen by diving doctors, and benefit from more appropriate assessment including specialist investigation if required."

Charges for consultations might be as high as, or higher than, those charged by GPs but the level of medical assessment would be advanced, and charges would accrue only when there was a specific malady to investigate.

UK SDMC member Dr Chris Edge, who also advises the BSAC on medical matters, expects the new system to be more popular than the old. "GPs are not as well equipped to recognise problem areas as doctors with knowledge of diving physiology," he told *DIVER*. "And on top of the questionable effect of GP examinations, it was known that many divers balked at the varying and sometimes high charges, £60-odd, levied by GPs for their services. A lackadaisical approach by some GPs was also a factor in the move for change. We have evidence of cases where certification of medical fitness to dive was granted to people with asthma, and others with diabetes, possibly because the doctor had simply not read the guidance notes properly. We decided that enough was enough."

Divers who have previously suffered from decompression illness will be passed as fit to dive as long as, when they complete the new questionnaire, they include a copy of a previous Certificate of Fitness to Dive issued by a medical referee following a DCI incident.

Divers would be required to fill out a UK Sport Diver Medical Form annually, on club renewal. Signed forms returned without ticks in any of the questionnaire boxes will result in a Certificate of Fitness to Dive, or the continuing validity of a certificate already held. Any temptation to conceal ailments would be tempered by the standing of the signed form as a legally binding document which, later, could invalidate insurance policies, club schemes or personal, if irregularities came to light.

Information on the proposed revised UK Sport Diving Medical Form is available on the UK Sport Diving Medical Committee's website <[www.uksdmc.co.uk](http://www.uksdmc.co.uk)>.

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