

## A REVIEW OF AIR EMBOLISM AMONG SCUBA DIVERS IN THE MONTEREY PENINSULAR

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The controversy over whether the novice scuba diver should be taught "free ascent" before receiving his diving certificate will always remain. Personally I feel that the diver should not attempt a free ascent until his or her third ocean dive and then only after practice under supervision in a pool. A second, though sometimes impossible condition is that no free ascent should be taught where a recompression chamber is not available nearby with an MD and operating personnel at immediate readiness.

Besides emphasis on the need to expel air as one ascends, the fact that severe and forced expiration before starting the ascent should be avoided also needs to be explained. Last summer I had two cases of air embolism which could only be explained on the basis that initial forced expiration closed off some of the lower lobe terminal bronchioles which then remained closed resulting in over expansion and rupture of alveoli and subsequent embolism.

From 1971 through 1974 a total of ten cases of air embolism or possible air embolism were treated on the Monterey Peninsular, California. Of these, three were embolized during the practice of "free ascent" as a part of their last ocean dive to qualify for the novice certificate. Known cases were 1971 - one, 1972 - two, 1973 - two and 1974 - five cases.

### Cases incurring Air Embolism while practicing FREE ASCENT

#### **Case 1 (1972) Male, age 21**

On first ocean dive, panicked during free ascent from 25 feet. Did not exhale for the last 15 feet of ascent. Became unconscious within 2 minutes of surfacing. Compressed to 165 feet approx. 20 minutes after losing consciousness, regaining it after 10 minutes at 165 feet. Flown to San Diego on Table 4 (in 1-man chamber). Treatment was finished up on Table 6 with O<sub>2</sub> from 60 feet at San Diego. Victim was blind for three days after treatment but sight returned spontaneously. Psychometric examination at UC Medical School showed no neurologic deficit.

#### **Case 2 (1974) Male, age 30**

Complained of weakness after second "free ascent" from 25 feet. Buddies in class removed his weight belt and tank and entire class started for shore. His wife looked back to see how he was and found him floating unconscious and drowning. He was brought ashore, and then to hospital by ambulance.

He required 1 hour of intensive resuscitation from severe drowning before I could place him in our chamber. He was taken down to 165 feet while barely conscious and then transported to San Diego on Table 4. Treatment was completed on modified Table 6 on O<sub>2</sub>. Recovery was complete.

#### **Case 3 (1974) Female, age 25**

Complained of chest pain after free ascent practice from 25 feet. She was brought to shore where she also developed dizziness. Examination at hospital revealed no nystagmus but there was loss of vibration sense in the left ankle. There was no muscle weakness and the remainder of the neurologic examination was negative. Chest pain had disappeared.

Since our chamber had not been returned from San Diego, she was placed in Trendelenberg position 10°, IV Saline was started and 100% Oxygen given while being flown to San Diego at 500 feet altitude. She entered their chamber approximately 3 hours after the accident.

It is interesting to note that her headache was slightly worse on reaching San Diego and she developed severe nystagmus on sitting up to enter the recompression chamber. Vertigo, nystagmus, loss of vibration sense, and headache all cleared within 10 minutes after recompression to 165 feet. She remained asymptomatic after leaving the chamber.

#### Other causes of Air Embolism

##### **Case 4 (1971) Male, age 28**

On his third ocean dive, with an instructor, he was down at 75 feet when he came to a rock about 25-30 feet high. He was excited and thinks he forgot to let his breath out as he came up over the rock. He became hemiplegic as he passed over the rock. His instructor saw that he was "in trouble" and assisted him to the surface and then to the shore. He was disorientated, unable to talk and unable to move his right extremities so was taken to the Pacific Grove Fire House. There he was found to be orientated as to time and place, able to talk and had recovered ability to move all extremities. However, there was residual weakness in his right arm and leg. Tongue did not deviate. Right biceps and knee showed hyperactive reflexes. Babinski was negative.

He was taken to 100 feet in our single-lock chamber and treated on Table 1A. He was completely asymptomatic at the end of treatment.

##### **Case 5 (1972) Male, age 19**

On his first ocean dive with the class he was down at 60 feet with his instructor, who later described how he took his eyes off the victim for a couple of minutes and when he looked back he saw the victim on the bottom with his mouthpiece out. The instructor panicked and pulled him to the surface without forcing air from the victim's lungs. Haemoptysis was observed on surfacing. It took 30 minutes to get him to shore from the dive site, during which time he was unconscious and remained so when placed in our chamber. He was transported by air to San Diego on Table 4. Death occurred after the small chamber had been placed within the larger San Diego one, before pressure was equalised.

##### **Case 6 (1973) Male, age 28**

This uncertificated diver with 2 years diving experience was found unconscious in 30 feet of water. He was pulled to the surface by his buddy without forcing air out of his lungs and reached the hospital approximately 30 minutes after the accident. Pupils were barely reactive, there were no deep tendon reflexes, he was breathing spontaneously and blood pH was 6.8 with arterial O<sub>2</sub> saturation 48% on arrival there. He required 1 hour of intensive resuscitation measures before I thought he could survive the usual three hours before he would reach the San Diego chamber for treatment. Such therapy was chosen because air embolism could not be excluded by the case history obtained. He was air transported on Table 4. He was treated on Table 6 three times in three days at San Diego Naval Hospital, being discharged apparently completely recovered 6 days after the accident.

**Case 7 (1973) Male, age 16**

Regulator trouble was encountered at 90 feet depth, necessitating an emergency ascent. Intermittent loss of consciousness occurred over the next 20 minutes. The patient received 500cc IV saline, 20 mgm decadron, and oxygen while awaiting the arrival of our chamber by air transport from Monterey to Eureka. He was then placed in this on Table 4 schedule and taken to San Diego, treatment being completed there on Table 6 on O<sub>2</sub>. Recovery was complete.

The portable one-man hyperbaric chamber is single lock, air or oxygen capable, manufactured in Italy, 800 lbs, 6'4" length, 28' diameter (32" at hatch). It is kept at the Pacific Grove Fire Department for emergency use by the Marine Rescue Patrol. It can be transported by helicopter, the one used being a USOG H-3 (large). It can be placed within the large chamber at Catalina through the 29" door by dint of great luck, much angulation and less than 1/64th inch "clearance". An article about the operation of our Rescue Patrol and some of the problems we have encountered will be printed at a later date.

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Drugs from the sea

Mr Richard Helms, former director of the US CIA told the Senate committee on Intelligence that included among poisons stockpiled there was lethal shellfish toxin.  
(*The Australian*, 19 September 1975)

The new Physiology (1)

According to the director of the Sydney Human Performance Laboratory, the Parramatta players "had performed beyond the limit of human endurance". It just shows the value of training!  
(*The Australian*, 29 August 1975)

The new Physiology (2)

It as reported that Mr Frank Braun, 1968 president of the South African Olympic Committee, once gave as the reason for the absence of blacks in South African swimming team, that "Some sports the African is not suited for. In swimming the water closes their pores and they cannot get rid of carbon dioxide, so they tire quickly". An interesting observation!  
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The new Physiology (3)

Prof. Leston L Havena, Professor of Psychiatry at Massachusetts mental health centre at Harvard Medical School has said that most people are psychologically dead by the time they are 30. "They go on breathing for a lot longer than that but from a psychological point of view it would be hard to find signs of life." A Canberra team of academics and researchers has worked for nine months to reveal that human beings are limited in their capacity to learn. They observed that what a team decides is the solution of a problem may be different from the solution that any single member of the group might have arrived at. All things considered, it is lucky that the ages of the SPUMS committee are to be kept strictly secret!  
(rewritten from the *Daily Telegraph*, of 23 July and 14 October 1975)