

## ORIGINAL PAPERS

### MID WATER AIR EMOLISATION CASE REPORT

Douglas Walker

#### SUMMARY

The victim was a 13 year old girl making her first open water scuba dive after certification. It was her fifth open water dive. As the dive master on the boat was aware that she was a novice great care was taken in choice of a suitable buddy. While swimming, with the buddy a little in advance, in the mid water zone she was for a short time out of her buddy's view and lost consciousness during this period. This seems to indicate the time when she suffered her arterial air embolism. The condition was clearly demonstrated at the autopsy.

#### THE INCIDENT

This boat dive was organised by a dive shop to a reef that ran between two off-shore islands. There was a dive master aboard and he was aware that the victim had only just completed her dive course so he selected for her buddy a diver with over three years of experience who had achieved a dive master qualification eleven months previously. The buddy checked their tank contents gauges. When he saw that her tank had 2600 p.s.i. while his had 3100 p.s.i. he told her that when either diver's gauge reading fell to 300 p.s.i. they were to ascend together. He also reminded her of the teaching that if separation occurred there was to be a one minute search before the divers surfaced to rejoin each other. The skipper anchored at the reef and told the divers that the depth below the boat was 15 m, which pleased the buddy as he knew novices should not dive deeper than 18 m.

There was a reasonably strong current so the buddy planned to make a compass dive into the current, which would result in an untiring drift back. When they descended to 15 m. they discovered the sea bed was still far below. The buddy signalled that they should level off, which she managed without requiring any help. He then started the compass course swim. The visibility was good and they could see the sea floor 6-9 m below. The buddy led with the victim close by and he made frequent checks of her condition, exchanging "OK?" signals. He checked his bottom time and saw that 10 minutes had elapsed, then looked round and saw the victim above him, one arm held up in the manner adopted when about to reach the surface. He swam to her and saw that her regulator was out of her mouth and there was a green liquid pulsing from her mouth: He thought this was vomit but later realised was blood. He placed his own regulator in her mouth, and commenced using his reserve regulator, trying to keep it at the side of her mouth to allow escape of the apparent vomit.

While he was doing this they sank down to the sea floor, at a depth of 27 m. He was uncertain whether she was conscious or not at this time. He brought her to the surface with her head back, the standard procedure he had been taught. He observed that there was no sign of breathing and that it was blood, not vomit, emerging.

As soon as he surfaced he gave a distress signal, which was quickly acknowledged from the boat, which was about 50 m away, then inflated her buoyancy vest and started to tow her. The divemaster had ditched his gear and dived in from the boat as soon as he saw the need for assistance. When he reached them he noticed the pink froth at the victim's mouth, then ditched her weight belt and took over the towing while the buddy gave EAR as he swam alongside. On examination in the boat no pulse or breathing was noted. CPR was started and this was continued during the return trip, death being formally declared when they reached the wharf. She had been scuba diving for 14 minutes before being brought to the surface, dead.

The autopsy was correctly managed. X-ray films of both head and chest were taken before commencing the internal examination. Air was shown in the heart chambers, especially the left ventricle, and in the aorta, and possibly in the pulmonary arteries. There was no pneumothorax. The lungs appeared dense. Air was present in the arteries of the Circle of Willis at the base of the brain. These findings support a diagnosis of cerebral arterial gas embolism (CAGE), so her loss of consciousness is readily explained. The blood vessels on the surface of the brain contained many small bubbles. Both of the lungs showed marked oedema and the posterior visceral pleura showed petechial haemorrhages consistent with anoxia. The trachea and bronchi contained slightly blood-stained foam consistent with drowning. There was no obvious area of lung rupture indicative of major barotrauma. Histology revealed the presence of a widespread intra-alveolar extravasation of blood. Such would not be expected in simple drowning.

#### DISCUSSION

The critical path of this tragedy included several adverse factors and these became greater in their influence on the course of events than the positive factor of having a well trained buddy who attempted to maintain good contact with the victim. There may be doubt about the wisdom of certifying such young persons but no details are available concerning the emotional maturity of the victim, a factor of importance in a discussion of this matter. Of most immediate effect on this dive was the factor of being in mid water far above the security of a nearby sea bed. It was only her fifth open water scuba dive so it is

probable the situation would be stressful, particularly as she was swimming against the current and trying to keep close to her far more experienced buddy. There was indeed frequent "OK?" check contact but, as the buddy told the coroner, no buddy keeps constant sight of his companion as he will on occasion look at the underwater scene and check his own gauges. The fact that he was swimming a little ahead of the victim was an adverse factor. There is uncertainty concerning the time for which the victim was out of his sight, but the fact that she was not far from him and above him implies that it cannot have been long as otherwise his swimming would have put him far ahead of her. So it is unlikely that she had time to ascend far before she lost consciousness and started to sink.

It is obvious that even the presence of a careful buddy is not a complete safeguard for a novice diver swimming in the never never depth of mid water in the open sea. Once again air embolism has been shown to occur without the victim (apparently) ascending a significant distance and without coming to the surface.

### **THE RIGHT TO DIVE, A CASE STUDY**

Douglas Walker

#### **SUMMARY**

For sheer determination, albeit misdirected, the victim of this incident must be awarded full credit. He was not only overweight with extremely poor sight but had suffered from an accident which so scarred his forehead it made obtaining mask sealing difficult. In addition he had a medical history which he partially suppressed. A consideration of his contacts with a series of medical practitioners and conscientious, reputable diving instructors forms the core of this report. None of the latter regarded him as fit for certification, all informed him of this fact, and on the fatal dive he was being "specialed", a degree of supervision given only to disabled persons having a visit to the underwater world but not regarded as being scuba divers. That he died was probably not a consequence of diving but rather an event which could have occurred at any time. But he was diving at the critical time and the efficient response of the instructors illustrated the value of the training they receive and the responsible response of the instructors illustrated the value of the training. A common fact of an autopsy report which disregarded relevance to the circumstances. This was made almost unavoidable by the practice of including only minimal information to the pathologist performing an autopsy. An additional element was the presence as an "expert witness" of a representative of a government department. His evidence, as has been the

pattern in previous instances where there has been a similar assistance offered to a Coroner, was based very firmly on an interpretation of the Diving Law and had minimal relevance to the actual circumstances of the case. The report is divided into sections dealing with the diving instructors, the actual incident, the medical examiners, and the pathologist reporting the autopsy. Throughout there is The Pupil, a victim of his medical problems but struggling to achieve his aim, the freedom of scuba diving.

#### **THE PUPIL/INSTRUCTOR INTERACTION**

Joe first attempted to obtain entry to a scuba course in 1983, presenting a medical certificate which mentioned this was a "conditional approval". It is not known what conditions were stated. This particular dive shop had a policy that each pupil must be unconditionally fit and he was told to obtain a further medical check. He returned in November 1984 but again the medical approval was "conditional". When he was examining brochures about the course he was noted to hold them close to his eyes in order to read them. The instructor therefore felt that if the applicant ever returned carrying a certificate to state he was medically fit he, the instructor, would demand his further assessment, by a "diving" medical practitioner.

In April 1985 he attended the first lecture of a dive course run by another dive shop. He was instructed to bring a medical fitness certificate and the staff noted his extremely poor sight, excessive weight, and a deformed forehead which had the effect of making it difficult to fit a mask. He was noted to hold a paper 4 inches from his eyes to read it. The diving instructor spoke to him after the second lecture, pointing out to him that diving was not in his best interests and would be a safety risk not only to himself but to others. He got quite upset and stated it was unfair, that he had a right to choose whatever he wanted to do. He brushed aside the suggestions of alternative sports he might undertake. It was agreed he could attend the first pool training. It was with difficulty that a suitable wet suit was found, and the size of his abdomen was a problem in finding a weight belt. The pool was only 4 ft deep and the day sunny but he was unable to read the gauges or his diving watch. He seemed slow to learn and it was difficult to obtain a water tight seal for his mask. He appeared to accept the verdict that he discontinue the course but arrived at the next lecture. He was again told he was totally unsuitable for scuba diving and a danger to himself and others, was spoken to at some length of the problems of scuba diving, even told that he was a candidate for a heart attack, and offered a refund if he attended a diving medical centre and brought a certificate stating he was "unfit to dive". The instructors were entirely confident such a certificate was appropriate. Then he claimed the right to attend the remaining lectures as he had paid for the course. He was not allowed to sit the written examination at the end of the lectures, a precaution designed to prevent a later