

Opinion

South Australian diving-related deaths 2001–2: an alternative view with discussion of responsibilities of an ‘expert witness’

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Key words

Diving deaths, investigation, expert witness, theory-based advice

Abstract

(Walker D. South Australian diving-related deaths 2001–2: an alternative view with discussion of responsibilities of an ‘expert witness’. *SPUMS J.* 2004; 34: 218-20.)

The reports by the State Coroner of South Australia on five diving-related deaths that occurred during 2001-2002 are discussed. Non-medical factors are proposed as having been critical to the course of these incidents. The difference between the role of an ‘expert witness’ and that of an ‘advisor to the coroner’ is discussed.

Introduction

There has been international legal, media and political interest in the findings of South Australia’s State Coroner concerning the critical factors incriminated in several diving-related deaths that occurred in the period 2001–2002.¹ A recent medical report has provided a rare opportunity to observe the involvement of an ‘expert witness’ in advising a coroner on the interpretation of the facts presented and therefore in his reaching his formal findings and recommendations.² This paper reviews the information the Coroner has made available concerning these cases, summarising relevant issues briefly, and reaches a different conclusion from that of Acott.² Attention is drawn to the importance of those advising any coroner to be careful to avoid proposing as facts matters that are opinions, because of the consequences which may flow from the coroner’s reliance on the advice.

Case reports

CASE 1

This diver had recently undertaken a refresher course. Although described by her son as being very experienced, the dive supervisor appointed a diving instructor to be her buddy. When she became aware her contents gauge showed it was appropriate for her to ascend her buddy persuaded her to make a 20.7-metre solo ascent while the buddy continued to hunt for crayfish. A cry for help was heard by the ‘surface cover’ but ignored. Clinically, this was a case of cerebral arterial gas embolism, though no autopsy evidence was found. The medical history, not divulged in a diveshop questionnaire, included a spontaneous pneumothorax with unilateral pleural ablation treatment, chest infections that were just possibly asthma and pneumonia but probably not, two occasions of seeking advice about equalising her ears, and pains following a gynaecological operation. It was put to the Coroner that

vertigo during ascent and the pleural adhesions were critical. No supporting facts were presented. The critical factors were her belief that by her remaining-air status she needed to ascend, and being asked to do this solo.

CASE 2

An infrequent diver, this obese man was wearing a tight wetsuit and using borrowed equipment. There is no mention in the available records whether he appeared to be unfit. One of his two buddies accompanied him to the surface when he was becoming low on air, holding onto his vest to prevent a too rapid ascent although it was not rapid, then descended again to continue hunting for crayfish. When left at the surface he had a partially inflated buoyancy compensator (BCD) and had been advised to fin back to the dive boat, face up. He was later found floating, dead, with a drum-tight BCD. The autopsy showed the presence of air embolism, pleural adhesions, hypertensive cardiomegaly, and body mass index of 32 kg.m⁻². The pleural adhesions were ascribed to a past road traffic accident. It was suggested that he possibly suffered gastric reflux and was suffering from ‘dive dehydration’ causing blood thickening which interfered with oxygen uptake. The pleural adhesions were described as a reason for the pulmonary barotrauma. There is no evidence for these suppositions. His cardiovascular fitness was certainly suspect but there was no evidence presented concerning his apparent fitness. The buddy’s action in restraining him during the ascent may have distracted him from correct breathing rhythm, while his tight wetsuit disadvantaged him further. The over-inflation of his BCD did not cause his air embolism and was probably a terminal event.

CASE 3

After an unhurried ascent with his buddy, this hookah diver began a surface swim to their dive boat. He made no call

for help before silently sinking to the sea floor. There is no information concerning his health history other than his son's comment that "*he had been diving most of his life and never had any problems*". However, he was obese, had a severely fatty liver, emphysematous bullae, and minor myocardial ischaemic changes. He was wearing a wetsuit so tight it required significant effort both to don and remove. His weight belt not only carried excessive weights, 20 kg, but was unditchable because it had shoulder straps that were under his BCD. He had not inflated his BCD. The cause of death was drowning, circumstances pointing to this having followed a sudden fatal cardiac arrhythmia. There is nothing to indicate his health this day was any different to that on his many previous dives. He must have been aware of his limited effort tolerance.

CASE 4

This woman was regarded by her buddy as "*a not overly confident diver due to being unfit and overweight, which restricted her mobility*". During the snorkel swim in calm water to the dive area she requested to make several rests. Believing herself to be underweighted, she took an additional weight from her buddy. The final weight she carried, 18 kg, was considered excessive for her. After a short period diving she indicated a need to surface to rest on some nearby rocks. The two divers were washed off the rocks by an unexpected wave and she was repeatedly submerged by following waves, losing the regulator from her mouth. She drowned despite the attempts of her buddy to save her. She failed to inflate her BCD or ditch her weight belt; lethal errors. The coroner was advised that oesophageal reflux may have occurred causing laryngeal spasm, or that she was sedated by codeine taken for back pain, although the toxicology tests showed no codeine. She was a thoroughly unfit person but died because she failed to respond correctly to the unexpected immersion, her inexperience and carrying of excess weights, which she did not ditch, being critical factors.

CASE 5

This diver had been advised by his cardiologist that he should not dive, a fact which he made known to his dive companions. This was to be a deep dive, 37 msw depth, to recover an anchor and a sunken dinghy. He stated his intent to make his dive short, in partial acceptance of the medical advice. When he became separated from the others on the sea floor by a silt out from disturbed sand, he failed to ascend. He met the next pair of divers and snatched the regulator from the first, who snatched his buddy's, who fortunately then used her octopus regulator. They then started a rapid ascent in daisy-chain formation. After about seven metres' ascent the regulator he had snatched was noticed hanging loose, now minus its rubber mouthpiece. It is not known whether he resumed use of his own regulator or made an out-of-air 30 metres' ascent. His original buddy decided to descend again to make a deco stop and there found his friend floating, dead. Although he was obese and

had cardiomyopathy with a past history of cardiac failure, the critical factor was allowing himself to become low on air rather than ascending as would be indicated after separation. Wearing a tight wetsuit jacket was unhelpful.

Discussion

The Coroner correctly noted that in all five cases there were medical factors that would have been identifiable at a medical examination had a completely honest medical history been provided. However, it does not necessarily follow that these conditions were the critical factors that decided the fatal outcomes of these dives. It is suggested that it was the actions of the deceased, and their fellow divers in some cases, which were critical, as evidenced by their having safely dived on previous occasions with these health problems and by analysis of the dive details.^{1,2} It is clear that in cases 3, 4 and 5 the divers were well aware of their adverse health factors, which did not require identification by a dive fitness medical, but chose to scuba dive. Diver 1 would have considered himself fit, while diver 2 was a large, obese man who would have been aware that his tight wetsuit was clearly unhelpful to him, but would not have considered himself at risk of sudden cardiac death. A medical check would most likely have resulted in a prescription of medication rather than imposition of a severe restriction to his activities. Unfortunately there is no information concerning his effort tolerance.

The role of an expert witness in a court of law may be as either an advocate for one participant's case, or as an impartial and dispassionate advisor to the court on agreed facts. In the former he can be questioned concerning his statements, in the latter there is no such safeguard. Therefore, it is important that an expert witness makes it clear when he is presenting a personal opinion rather than undisputed fact. It is clear from the published findings that the Coroner based his findings on the medical advice provided and gave less weight to the details of the incidents.

It is informative that Acott introduces his paper with the statement "*five of these deaths were associated with medical conditions that were incompatible with safe diving, such as a body mass index of greater than 30 kg.m⁻², cardiomyopathy, asthma, lung bullae, pleural adhesions, poor physical fitness, and controlled cardiac failure*".² Certainly, these conditions are adverse to physical activities such as scuba diving, but reference to the literature confirms that many active divers have adverse health conditions.³

A belief in the reliability of medical examinations may be muted by consideration of the case where at least two formal examinations and a (misread) chest X-ray in a military diver failed to diagnose a chronic pneumothorax.⁴ He had continued active diving despite this condition. In the United Kingdom there is an appeal procedure available to those refused a medical certificate of fitness to dive (UK Sport Diving Medical Committee) and it is clear they have a more liberal attitude to such decisions despite being subject to

the same level of legal risk as in Australia if they are proved wrong.⁵ It is probable that the advice given the Coroner concerning the influence of the health factors was weighted by his expert advisor's above-stated beliefs.

The Coroner, in apparent deference to medical advice, gave low significance to the factors of inexperience, tight wetsuits, inadequate training, failure to monitor air supply, incorrect weighting, failure to ditch weight belts, and the failure of an instructor buddy to follow correct procedure. The Coroner made no mention of these factors in his well-publicised recommendations on these cases, restricting himself to discussion of the medical findings.

Opinion

It is important when providing considered advice concerning the apparently critical factors in a diving-related fatality that there should be attention to all the details of the incident rather than too great a focus on factors that may be considered adverse but are not demonstrably involved in the case under discussion. It is salutary to remember a comment attributed to Samuel Johnson that

"it is incident to physicians, I am afraid, beyond all other men, to mistake subsequence for consequence."

Undoubtedly, this warning is applicable to far more than physicians but it is particularly apposite when providing evidence or opinion in a court of law.

It is proposed that in at least four of these fatalities the critical element lay in the actions of those involved rather

than the medical conditions found to be present, and that the divers involved were not in ignorance of the medical factors recorded. In consequence of the expert advice he was given, the Coroner's recommendations concerning these cases were directed solely to medical factors of lesser significance than dive-management errors.

References

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Dr Acott replies:

Thank you for allowing me to address Dr Walker's criticisms, which appear, in part, to be based on a 'blinkered' view of events. Accident details available to the primary investigators are often overlooked or their significance dismissed by 'investigators from afar'.

The role of an 'expert witness' in the legal process to either give an opinion or clarify a complex medical situation is clearly defined prior to the commencement of proceedings. Expert opinion can be debated at any stage. The coronial process is not to establish blame but to establish facts. The Coroner's conclusions and recommendations are based on evidence, expert opinion and information gathered during an inquiry. The Coroner's findings in the recent cluster of South Australian diving deaths followed this process. 'Expert witness' opinion is considered in reference to all the other evidence. I am sure that if Dr Walker had been present during the Inquiry he would have found this to be so.

In Case 1 the critical factor was not "*her belief she was required by her remaining air to ascend*"; there was no indication that she was anxious or about to panic. Is Dr Walker suggesting that a solo ascent caused her death? The

Diving Incident Monitoring Study has shown that vertigo underwater can be nearly fatal. The combination of a Valsalva and continuing to ascend may have embolic consequences; however, vertigo was not considered critical as Dr Walker claims. The postulated cause(s) of death are clearly stated. The most significant factor in this report was the presence of two dive medical forms – one stating she suffered from 'lung problems' the other one that she did not. This was the basis for the Coroner's recommendation number 3.

In Case 2 it was not suggested by me (read the commentary) that he suffered from gastric reflux or 'dive dehydration' – nor did the Coroner make any reference to this. The postulated mechanism for death is clearly stated. There was no suggestion that an over-inflated BCD had caused an air embolism.

Cases 1 and 2, however, do highlight the problems associated with diving in 'threes' – having too (2) many buddies – someone is always 'solo'!

In Case 4 Dr Walker stated "*she was a thoroughly unfit person but died because she failed to respond correctly to the unexpected immersion, her inexperience and carrying excess weights, which she did not ditch, being critical*

factors.” Dr Walker has made this observation (failure to ditch the weight belt) consistently in regard to diving deaths without any explanation of the context of divers’ deaths.¹ Caruso has tried to address this problem in his analysis of DAN’s database concerning diving deaths:² “*People are unable to make critical decisions while hypoxic*”. Her buddy noted the deceased to be cyanosed when he reached her. There are many reasons for her becoming hypoxic in addition to her aspiration: obesity, tight wetsuit and immersion would all increase the A-a gradient and an increase in oxygen consumption would be expected due to excessive exercise in an unfit person. She was also the only case noted at post mortem to have food and gastric fluid throughout the laryngotracheobronchial tree. In addition, she was the only one noted to have suffered from gastro-oesophageal reflux (GOR), which can be (and usually is) made worse by immersion. Mendelson noted 60 years ago that aspiration of gastric contents, in particular food, is a terminal event.³ There is no suggestion in the reports that codeine was involved in the death; it was part of her medical history. She died because immersion plus swallowing water made her GOR worse causing respiratory embarrassment, and because she attempted to do a surface swim of 200 metres that she was unfit to do.

In Case 5 Dr Walker states “*the critical factor was allowing himself to become low on air rather than ascending*”. I suggest he re-reads what happened. The deceased, an experienced diver, depleted his air supply within minutes of immersion and grabbed another diver’s second stage who in turn had to use the octopus regulator from a third diver. The deceased began to ascend pulling the others with him. He then disappeared. His post-mortem chest X-ray showed pulmonary oedema consistent with left ventricular failure and gas within the heart. The pathophysiological events are discussed in the article so I will not elaborate further.

Bitten tongues noted at post mortem can be and usually are indicative of a convulsion (personal communication, J Caruso, Pathologist, DAN, 2004). A convulsion following ascent would strongly indicate that the diver had suffered from an embolic event. Three of the deceased (Cases 1, 2 and 5) were noted to have a bitten tongue at post mortem. Areas of pulmonary compliance change are associated with embolic events.⁴

I would suggest that no person would consider himself or herself at risk of a sudden cardiac death. People dive with conditions that are considered by some to be contrary to safe practice and while they may dive uneventfully for a while it is possible that interplay of situational factors may result in a fatal outcome. Just a little more exertion on the dive, an episode of aspiration or a more rapid ascent than usual may be all that is required. Accidents are unpredictable and can be the products of unlikely coincidences or errors occurring at an inopportune time when there is no ‘system flexibility’.⁵ Even trivial errors can have catastrophic results if they occur at the wrong time. The ‘system’ can be regarded as the ‘scene setters’ or ‘latent errors’.^{6,7} Dr Walker’s

military diver illustrates the importance of Alnutt’s ‘system flexibility’. A cardiovascularly fit, young, military diver has a greater ‘flexibility’ compared with an obese, cardiovascularly compromised, middle-aged diver, and military diving differs enormously from recreational diving.

South Australia is unique in its process of investigating diving fatalities. The Coroner insists that all diving deaths are investigated by the police diving unit, that a diving medical representative from the Royal Adelaide Hospital’s Diving Hyperbaric Medicine Unit is present at all post mortems and that this representative is familiar with all the known facts immediately prior to attending.

Having a database of over 1500 incidents in the Diving Incident Monitoring Study I am sure that I do not “*mistake subsequence for consequence*”. In fact, I am a believer in *mortuis vivos docet* (the injured teaches the uninjured). I suggest that Dr Walker re-acquaint himself with the physiology of obesity, hypoxia, immersion and the Frank Starling mechanism.

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