CORONERS ACT, 1975 AS AMENDED

SOUTH  *AUSTRALIA*

FINDING OF INQUEST

An Inquest taken on behalf of our Sovereign Lady the Queen at Adelaide in the State of South Australia, on the 23rd, 24th, 25th and 25th of February 2004 and the 6th day of April 2004, before Wayne Cromwell Chivell, a Coroner for the said State, concerning the death of Neville Arthur Kinnear.

I, the said Coroner, find that, Neville Arthur Kinnear aged 58 years, late of 58 Aroona Road, West Croydon, South Australia died at Snug Cove, Kingscote, Kangaroo Island, South Australia on the 15th day of April 2001 as a result of salt water drowning following air embolism due to ascent barotrauma.

1. Introduction

1.1. On Sunday 15 April 2001 Neville Arthur Kinnear went scuba diving with friends at Snug Cove on the Southern coast of Kangaroo Island. They were hunting for crayfish.

1.2. Mrs Marlene Kinnear said that her husband was a qualified diver, having passed his 'exams' some years earlier. She said that he did not dive often, but enjoyed it when he did (Exhibit C7a, p1).

1.3. There were seven divers in he group. Mr Kinnear was 'buddied' with Ian and Janice Myers. Mr Myers' description of what occurred during the dive is as follows:

> 'Neville was with Jan and myself. I don't know what time we entered the water. Neville was wearing a wet suit and hood, boots and gloves. He was using my dive tank, which is a single 'Boss Steel' 88 or 90 cu foot capacity. The normal hoses and regulators were

fitted to the tank. He was wearing a 15kg weight belt and a BCD (Buoyancy Control Device), Scuba Pro brand.

The 3 of us entered the water, we were the last group to go into the water. The water was clear, with a little bit of current and about 6-8 metres of visibility. The object of the dive was crays. We were diving in about 9 metres of water and about 20 minutes into the dive I found a cray in a crevice and I motioned to Neville to have a look as he had never seen a cray in the wild. He had a snare and tried to get it but missed. I checked our contents gauges after he missed and Jan and I had 100 bar left and Neville had 50 bar. Bottom time at that depth was about 1½ hours on a full tank but this varies from person to person and conditions.

I motioned to Jan to stay where she was and motioned to Neville to ascend. He signalled back OK and we started ascending. I don't know if he was over weighted or not but he wasn't going up very fast. He is a big man, about 6'11" tall and 16-17 stone. I took hold of the front of his jacket to stop him coming up too fast if he decided to inflate his BCD vest. We surfaced about 40-50 feet south east of the boat. I asked him if he was OK and he said 'yes fine'. I told him to lay on his back and inflate his BCD and just fin back to the boat on his back, with his mouthpiece in. He said he was OK with that and I said I would go back down and get Jan and come back up to the boat. By the time I got down and got up with Jan, Neville was a bit further north of us. He was laying on his back and I thought he was hanging onto the mermaid line – a line about 25 feet long with a buoy and a dive flat, attached to the boat. I thought he was enjoying the sun. I got into the boat and took my gear off and called out to Neville but he didn't respond. Jan was still in the water at the back of the boat. I put my face mask back on and re-entered the water and swam over to Neville and grabbed hold of his vest and spoke to him but he didn't acknowledge me at all. I pulled him back to the boat, from about 30 feet from the stern. Whilst I was dragging him I noticed some vomit around his mouth. His mouthpiece wasn't in and his mask was in place and was clear. When I left him to go back for Jan his vest was about ½ inflated and when I returned to him from the boat it was fully inflated, it was almost drum tight. I can't understand why he had it so tight. The vest is inflated by depressing a manual inflate button that supplies air from the tank.

Dennis, Kate and Judith were in the water with Jan when I went back to get Neville. When I got him back to the boat we tried to rouse him to see if he was coherent or not. I took his weight belt off and tried to de-gear him so we could get him into the boat, all the time trying to rouse him without response. I deflated his vest by pulling the deflate cord and got his vest off. We man handled him into the boat. When I pulled him back to the boat initially he it looked like he was still breathing. After we got him on board I saw he wasn't breathing and checked his airway and saw it was clear and started CPR and mouth to mouth and Dennis grabbed the DAN oxygen kit. We couldn't get a pulse or any response. We had him on his side and sounded like he was full of water. We did CPR and mouth to mouth for about 10 minutes and Kate said he was dead (she is a physiotherapist).'

(Exhibit C56, pp2-3)

2. Cause of death

2.1. A post-mortem examination of the body of Mr Kinnear was performed by Professor R W Byard, Forensic Pathologist, on 18 April 2001. Also present was Dr C J Acott, Director, Diving Medicine at the Royal Adelaide Hospital.

2.2. Professor Byard diagnosed the cause of death as salt water drowning due to ascent barotrauma. The significant findings from the post-mortem examination were as follows:

- Mr Kinnear was 186cm tall and weighed 113kg;
- There was bilateral bruising of the tongue consistent with tongue biting;
- The airways were filled with white frothy liquid and there was marked congestion and oedema of the lungs;
- There was a small area of fibrous adhesions in the left pleural cavity. There was no air in the pleural cavities such as would indicate a pneumothorax;
- The heart was enlarged with thickening of the left ventricular wall;
- There was air in the right atrium when the heart was opened under water.

2.3. Professor Byard commented:

> 'Death was due to salt water drowning following air embolism due to ascent barotrauma. The presence of air demonstrated at autopsy within the right atrium was also confirmed by Dr C Acott on review of chest x-rays which showed a significant fluid level within the heart. Adhesions within the pleural cavity are known to predispose to air embolism. The present of frothy oedema fluid within the upper airways indicated that the deceased had inhaled salt water. Although there was significant cardiomegaly (655 grams), presumably related to hypertension, this was regarded as incidental to the cause of death given the preceding findings. No other underlying organic diseases were present which could have caused or contributed to death. There was no evidence of significant trauma. Toxicology was negative and blood carboxyhaemoglobin levels were not raised.'
>
> (Exhibit C9a, p1)

3. Medical issues

3.1. Dr Acott gave oral evidence at the inquest. He is a very experienced diver, and is one of Australia's leading experts in diving medicine. In his report, Dr Acott commented:

> 'Mr Kinnear drowned because of a cerebral arterial gas embolism (CAGE). Air was noted in his heart at post mortem and on a post mortem chest Xray (CXR). The CAGE

> would have caused unconsciousness and a convulsion (this was evident because of Mr Kinnear's bitten tongue). There were fibrous adhesions in his (L) pleural cavity (the pleural cavity is in the thorax between the lung and chest wall). These adhesions (which were attached to part of his lungs) were probably the result of earlier chest trauma suffered during a motor vehicle accident (MVA). These adhesions would have been evident on a CXR if one had been taken a few weeks after Mr Kinnear's MVA. In my opinion, these adhesions would have restricted the expansion of the affected part of his lungs during ascent, causing this part to rupture and in this process tearing a pulmonary vein and allowing any escaping gas to enter that vein. This gas would have then travelled to his heart and onto his brain (hence being called a cerebral arterial gas embolism). This gas would have then passed through the brain's circulation back into the heart – hence gas being found at post mortem.
>
> A convulsion underwater would have resulted in aspiration of salt water – hence he drowned.
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> IF he had had a diving medical performed by an medical practitioner experienced in diving medicine prior to him diving after his MVA he would have been warned about the hazards of diving with pleural adhesions in his chest/pleural cavity.'
>
> (Exhibit C66, pp1-2)

I will refer to a cerebral artery gas embolism as a 'CAGE'.

3.2. In oral evidence, Dr Acott said that Mr Kinnear was obese (he had a body mass index 'BMI' of 32. Any person whose BMI is over 25 is considered overweight).

3.3. This condition, combined with a lack of cardio-vascular fitness, would have placed stress on Mr Kinnear's cardio-vascular system, making him inclined to over-breathe. Additionally, his large stomach, when confined in a wetsuit, might also have caused gastric reflux which may have caused aspiration. Finally, dehydration caused during diving makes the blood thick, interfering with oxygen uptake, which makes one breathe even harder.

3.4. Dr Acott said a combination of some or all of these factors may have contributed to the process whereby air entered Mr Kinnear's circulatory system and caused a CAGE, convulsions, and drowning (T306).

4. Diving issues

4.1. Mr Kinnear's equipment was not tested. The only information available is that his weight belt weighed 13.8kgs (see the statement of Sergeant Pain, Exhibit C42a, p2). This is not considered excessive.

4.2. Senior Constable Darryl Wright of the Water Operations Unit of South Australia Police told me that having regard to the relatively shallow depth involved, there was no need for a decompression stop as Mr Kinnear ascended from the bottom (T283).

4.3. Senior Constable Wright also confirmed that it was quite appropriate and consistent with the 'buddy' system for Mr Myers to accompany Mr Kinnear to the surface, ensure that he was comfortable, and then return to the bottom to accompany his wife, whom he was also 'buddying' (T283). At the time he decided to return, there was nothing to indicate that Mr Kinnear was in difficulties.

5. Conclusions

5.1. I accept the evidence of Dr Acott, and find that Mr Kinnear died because he suffered a CAGE while ascending from the dive. Included in the contributing factors to this event were his pleural adhesions which restricted the ability of his lungs to expand, leading to rupture, his obesity, lack of cardio-vascular fitness, the tightness of his wetsuit, and possible dehydration.

6. General considerations

6.1. I have heard evidence in the inquests into the deaths of Robert Anthony Walker, Neville Arthur Kinnear, Rex Alexander John Humberstone, Deborah Christine Campbell and Jennifer Lee Barrington at the same time. These deaths occurred between 24 February 2001 and 21 April 2002. A startling number of similarities exist in these five cases:

- In three cases a CAGE (cerebral arterial gas embolism) was involved - Walker, Kinnear and Barrington;
- In four cases a lack of cardio-vascular fitness was evident - Walker, Kinnear, Humberstone and Campbell;
- Four of the deceased were obese - Walker, Kinnear, Humberstone and Campbell;
- All of the deceased had medical conditions relevant to the cause of death which could have been detected in a properly conducted medical examination:
    - enlarged heart (cardiomegaly) - Walker, Kinnear, Humberstone;
    - other heart disease (myocarditis) - Walker;

- lung disease - Kinnear, Humberstone, Barrington;
- back problems - Campbell, Barrington;
- oesophageal reflux - Campbell;
- ear problems - Barrington.

- In four cases, the deceased wore a wet suit that was too tight, interfering with breathing and possibly causing reflux - Walker, Kinnear, Humberstone and Campbell;
- In two cases, the deceased wore a weight belt that was too heavy causing excessive fatigue – Campbell and Humberstone; and in one case, the weight belt could not be quickly released - Humberstone;
- In one case the BCD was faulty, also causing excessive fatigue - Humberstone;
- In only one case did the 'buddy' system break down - Barrington;
- In two cases, poor diving technique may have contributed to the death - Walker, Campbell;
- Two of the deceased had recent diving training but were inexperienced - Campbell, Barrington, and the other three were experienced but had not had recent training - Walker, Kinnear, Humberstone;
- Three of the deceased had recently seen a doctor - Walker had been told by his cardiologist not to dive but ignored the advice; Humberstone had recently seen his General Practitioner but not in relation to diving; and Barrington had ignored her General Practitioner's advice to consult her surgeon, and had earlier misled the medical practitioner conducting the diving medical examination;

6.2. Dr Acott said that in his opinion all of these deaths were preventable. He said:

> 'A diving medical is required before a candidate commences scuba diving. This medical, in SA, does not have to be performed by a medical practitioner knowledgeable in diving medicine. (If the physics and unique physiology involved with diving and hence the problems are unknown the risks can't be discussed). Once the candidate is 'passed fit' he/she is fit for the rest of their lives. This is 'nonsense'. Commercial and professional divers are required to have an annual medical by a medical practitioner suitably qualified in diving medicine. However, annual diving medicals for 'recreational divers' are controversial. There needs to be some recommendation that states that if a diver suffers an illness or their medical or general fitness changes they should seek guidance from a suitably qualified medical practitioner regarding the risks that may be associated with

> continuing to dive. Perhaps annual self assessment forms should be introduced that will highlight problems which will then lead to a discussion with a suitably qualified medical practitioner.'
>
> (Exhibit C66, p4)

6.3. Dr Acott suggested that:

- Recreational diving medical examinations should be conducted by medical practitioners who are trained in diving medicine;
- The medical practitioner conducing the recreational diving medical examination (if he/she is not the subject's regular medical practitioner) should require the subject to produce a referral letter detailing the subject's medical history as far as it is known;
- Candidates should be made aware by the medical practitioner that health factors are a concern and are potentially lethal not only to the patient but to their 'buddies' in the water, so they are under a duty to disclose them.

6.4. Senior Constable Allen suggested that a public awareness campaign should be conducted to remind divers of the dangers associated with hookah equipment (Exhibit C21a, p13). Mr Humberstone's hookah equipment (as distinct from the BCD and weight belt) was not faulty and did not cause Mr Humberstone's death, so I am prevented by Section 25(2) of the Coroner's Act from making such a recommendation.

6.5. Senior Constable Allen also recommended that all recreational divers should undergo a regular medical examination (Exhibit C4a, p25).

6.6. Senior Constable Wright suggested that there are three options available to address these issues:

1. Do nothing;
2. Conduct an educational or public awareness campaign about the dangers of diving with a medical condition and recommending regular checkups;
3. Make periodic medical examinations compulsory.

6.7. Senior Constable Wright also pointed to the fact that occupational divers are required to undergo an annual medical examination by a medical practitioner trained in hyperbaric medicine.

6.8. The difficulties with option 3 are:

- Resentment from recreational divers;
- Expense;
- The lack of sufficiently trained medical practitioners;
- Unenforceability.

6.9. Senior Constable Wright commented:

> 'As recreational SCUBA diving is just that, a recreation, it is my opinion that it should remain as free from legislation and regulation as is safely possible. My preferred option would be Option 2, for the recreational diving industry to take steps to promote safe diving practices by the development of an education programme specifically aimed at the need for divers to maintain a good level of fitness.'
>
> (Exhibit C65a, p16)

6.10. Senior Constable Allen made a similar recommendation (Exhibit C4a, p25). I agree.

7. Recommendations

7.1. Section 25(2) of the Coroner's Act 1975 empowers me to make recommendations in certain circumstances following an inquest. The section reads:

> 'A coroner may add to his or her finding any recommendation that might, in his or her opinion, prevent, or reduce the likelihood of, a recurrence of an event similar to the event that was the subject of the inquest.'

7.2. Pursuant to that Section, I make the following recommendations:

1. All persons engaged in recreational underwater diving should undergo an examination by a registered general medical practitioner trained in hyperbaric medicine on a regular basis, preferably annually but not less frequently than every two years.

2. Medical practitioners should decline to conduct such examinations unless they are appropriately qualified to do so.

3. Medical practitioners conducting such examinations should, if they are not the subject's regular medical practitioner, require the subject to produce a referral letter detailing the subject's medical history as far as it is known.

4. Medical practitioners conducting such examinations should warn the subject that diving is a potentially lethal activity if undertaken by a person with certain medical conditions, and that absolute honesty in providing background medical history is called for.

5. If there is any doubt about the subject's health, the medical practitioner should arrange such follow-up tests as chest X-rays, hypertonic saline tests, or whatever else may be indicated, before passing the subject as fit to dive. Any doubt should be resolved against passing the subject as fit, until such follow-up tests demonstrate fitness to dive.

6. The recreational diving industry should conduct an awareness campaign among its member organisations and the diving public about the dangers of diving with certain medical conditions, the need for regular medical examinations at least every two years, the need for absolute honesty during such examinations, and the responsibility a diver has both personally and to his or her diving colleagues to ensure that he or she is fit to dive.

Key Words: Drowning; CAGE; Underwater Diving; Hyperbaric Medicine

In witness whereof the said Coroner has hereunto set and subscribed his hand and Seal the 6th day of April, 2004.

Coroner