

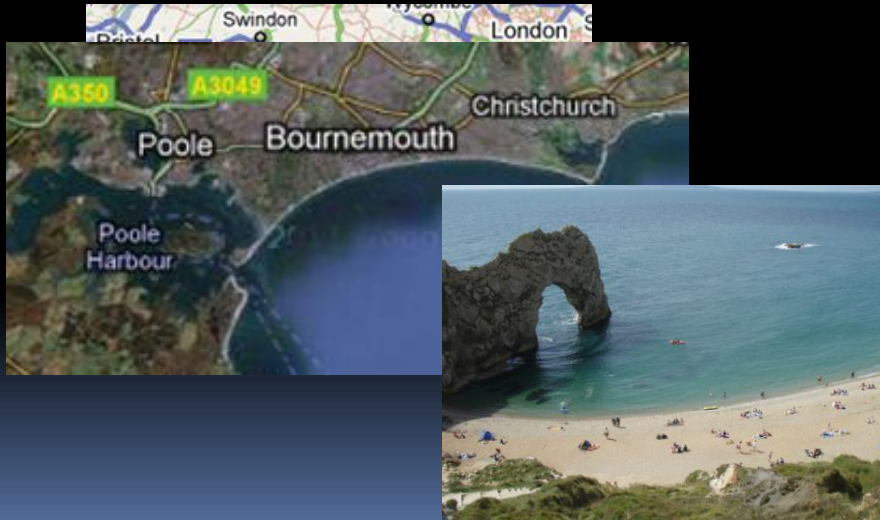
SHALLOW-WATER BLACKOUT

THE PRODUCTION OF AN ILSF POSITION STATEMENT



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Background



The Ian Mackie Fellowship

- Continue his contribution to the international lifesaving community.
- Importance of the link between medical issues and their practical application by lifesavers and lifeguards.



A Position statement

- Guide National Organisations
- Practical Casualty Reduction Measures
- Topics discussed and approved by the Medical Committee
- Delegated to members of the medical committee
 - Dr Phil Dickinson – Ian Mackie Fellow
 - Dr Paddy Morgan – Medical Advisor to Surf Lifesaving GB



Excluding other precipitants to drowning

- Non, injured or weak swimmer that has become submerged
- Trauma related
- Cold water immersion
- Autonomic Conflict
- Faults in Re Breathing SCUBA circuits (These have been termed Shallow Water Blackout)

Excluding incidental collapse in water

- Everyone dies sometime!
- May occur coincidentally in water.
 - Incidence of death higher than expected
 - Catastrophic effects of loss of consciousness.
 - Problem not just limited to drowning deaths.
- Secondary pathology may occur as a result of the loss of consciousness in water making proving causation difficult.
- Shallow water drowning diagnosis on the base of history and lack of post mortem findings of alternative pathology.

Why “Shallow” Water Blackout

- Because its not deep water!
- Not an ideal term
 - Loss of consciousness during a “shallow” water apnoea dive proceeded by hyperventilation. (Where alternate causes of blackout have been excluded.)

A Case History

- Three 12 year old boys go swimming.
- Competition to see who can stay under water for the longest duration
- One notes older children hyperventilating prior to breath hold diving.
- The children dive to the bottom of the pool, the child who has hyperventilated suddenly loses consciousness.
- His body is recovered by lifeguards 2 minutes later from the bottom of the pool

Physiological Mechanisms

- Hypoxia associated with Hypocarbica
- Alteration in free calcium ions
- The "samba" Phenomenon
- Air Embolism

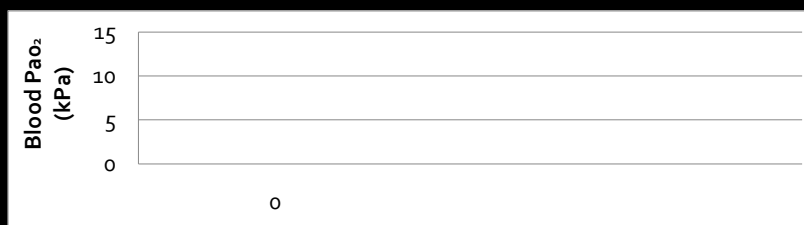
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Respiratory Drive from Hypercarbia

- Autoregulatory mechanism
- Carotid and aortic bodies
- Greatest blood flow per unit mass of any tissue
- Sense PaCO₂ via pH → Primary respiratory driver
- Also detect PaO₂
- Nerve impulse to brain stem via Glossopharyngeal and Vagus nerves

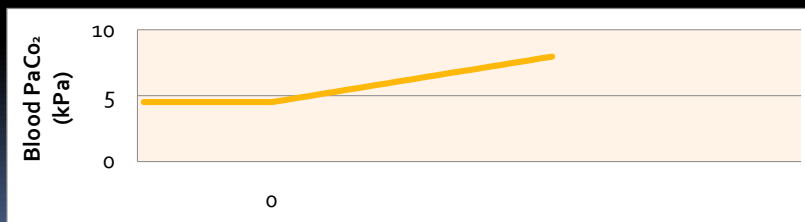
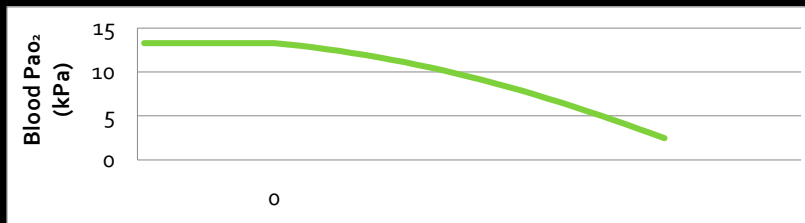
Breath Hold Dive



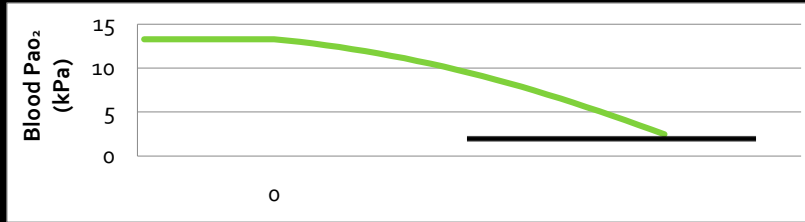
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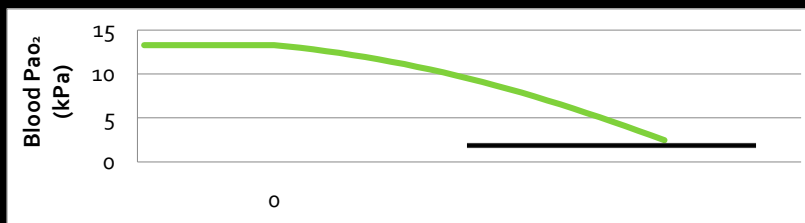
Breath Hold Dive



Breath Hold Dive



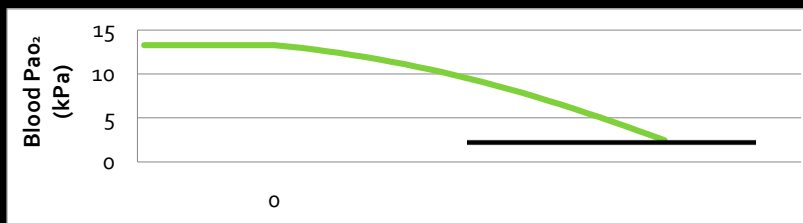
Breath Hold Dive



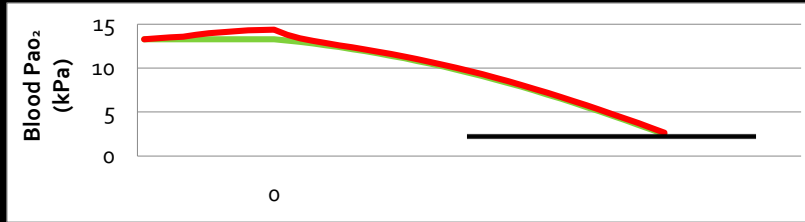
Hyperventilation and oxygen reserves

- With normal cardiac output P_{aO_2} relates to maintenance of conscious state
- C_{aO_2} is the measure of blood oxygen reserve.
- $C_{aO_2} = (Hb \times SpO_2 \times 1.34) + (0.022 \times P_{aO_2})$
- $C_{aO_2} = (19.7\text{ml } O_2) + (0.3\text{ml } O_2)$
- $C_{aO_2} = (\text{Fixed}) + (\text{Variable})$

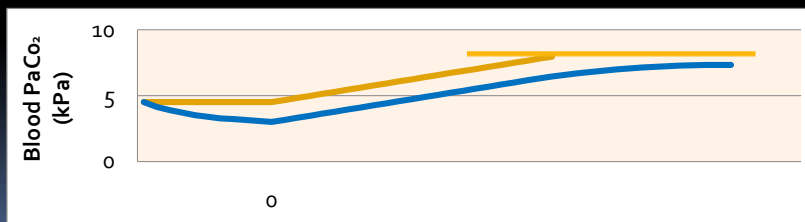
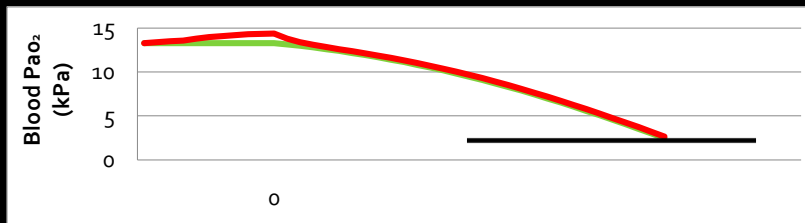
Breath Hold Dive



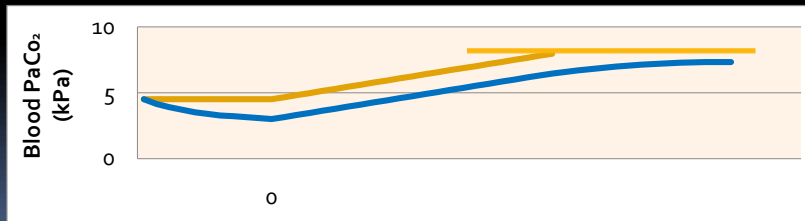
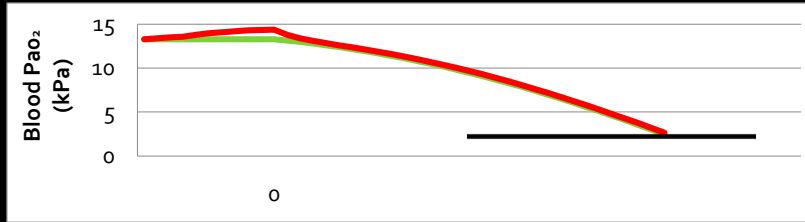
Hyperventilation prior too
Breath Hold Dive



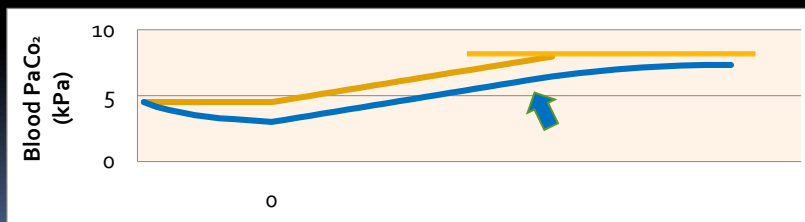
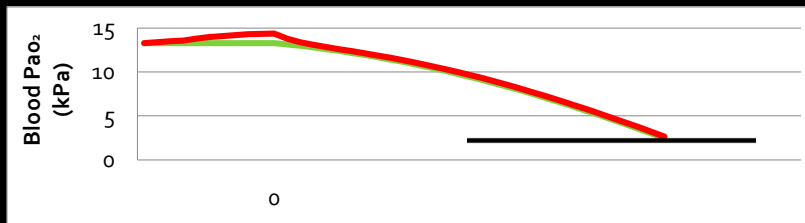
Hyperventilation prior too
Breath Hold Dive



Interpersonal Variation in Breath Hold Dive



Protective effect of exercise in Breath Hold Dive



Multiple hits

- Haemoglobin dissociation curve moves
 - Less O₂ release to tissues
- Cerebral autoregulation
 - Less cerebral blood flow
- [Ionised Calcium]
 - Reduces nerve impulse stimulus to breathe
- Hypoxic before cardiac arrest
 - End organ (Brain) damage starts earlier

Statements



- Prevention better than cure
- Safer if effective physical activity is continued. No attempts to breathe against a closed glottis are made and the depth of dive is less than 5m
- In the case of unconsciousness appropriate resuscitation protocols should be followed
- Shallow water blackout as a cause of death is a diagnosis that is difficult to make with certainty.

Recommendations

- Institute guidelines for water users that
 - Actively discourage hyperventilation prior to breath hold diving.
 - If an individual is stationary or showing signs of swim failure underwater following a breath hold dive there should be a low threshold for immediate rescue and recovery.



Standardised definition

- Shallow water blackout, ? Craig syndrome ?
 - Loss of consciousness during an apnoea dive to a depth of less than 5m preceded by hyperventilation. (Where alternate causes of blackout have been excluded.)

Global reporting

- ILS standardised data
- “Did the casualty deliberately hyperventilate prior to going under the water?”



Acknowledgements

- Dr Paddy Morgan – Medical Advisor to Surf Lifesaving UK
- Dr Anthony Handley – Chair, ILSF Medical Committee and Medical Advisor, RLSS UK
- The ILSF Medical Committee
- Professor Mike Tipton, Portsmouth University; UK



Take Home Message

**“Actively discourage
hyperventilation prior
to breath hold diving”**