

Fitness to Scuba Dive

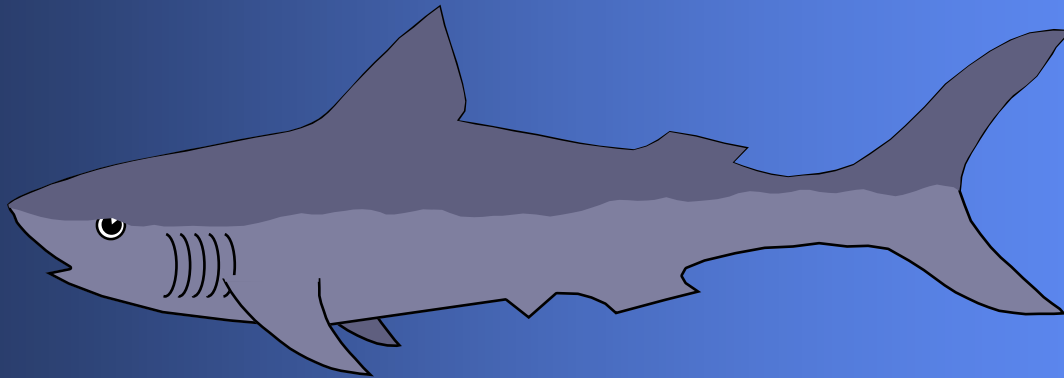
Critical Issues for GPs & Patients



Assoc Prof Tony Hochberg
Chief Medical Officer IPN/Kinetic

Objectives

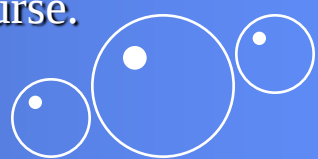
Basic understanding of Diving Physiology & Hazards with reference to assessment health risks for Sport Scuba Dive Trainees



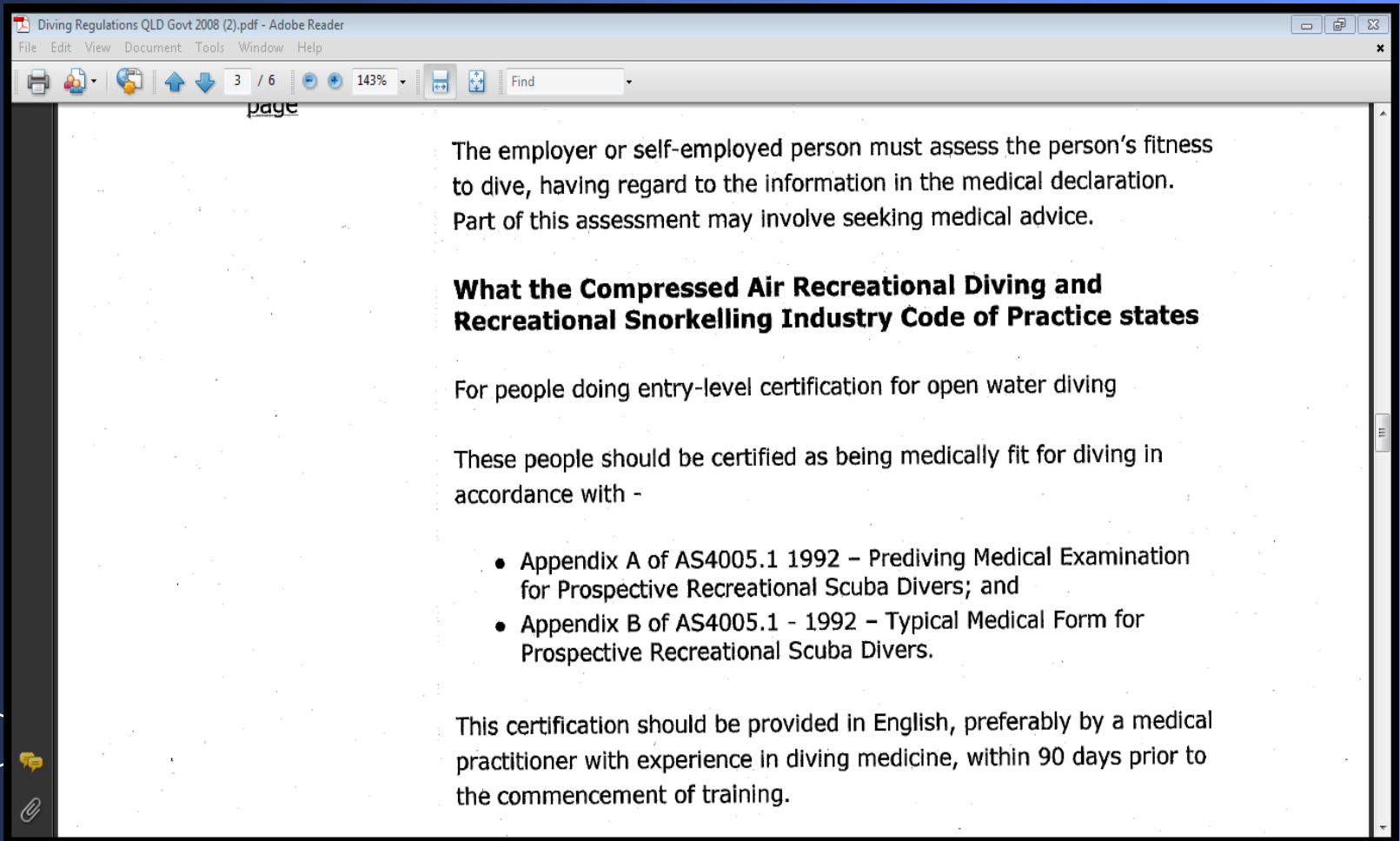


Queensland requirements for medical examiners commercial divers [June 2010]

- The certificate must be issued by a doctor who has satisfactorily completed training in diving medicine approved by the Board of Censors of the South Pacific Underwater Medicine Society (SPUMS).

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- Royal Adelaide Hospital Basic Course in Diving Medicine or the Advanced Course in Diving and Hyperbaric Medicine.
 - Royal Australian Navy Submarine and Underwater Medicine Unit Basic Course, Advanced Course or Medical Officer's Course.
 - Diving Medical Centre Medical Examiner Course.
 - Fremantle Hospital Medical Assessment of Divers Course.
 - Royal New Zealand Navy Basic Course.
 - Christchurch Hospital Basic Course.
- 

Workplace Health & Safety Regulations 2008



The employer or self-employed person must assess the person's fitness to dive, having regard to the information in the medical declaration. Part of this assessment may involve seeking medical advice.

What the Compressed Air Recreational Diving and Recreational Snorkelling Industry Code of Practice states

For people doing entry-level certification for open water diving

These people should be certified as being medically fit for diving in accordance with -

- Appendix A of AS4005.1 1992 – Prediving Medical Examination for Prospective Recreational Scuba Divers; and
- Appendix B of AS4005.1 - 1992 – Typical Medical Form for Prospective Recreational Scuba Divers.

This certification should be provided in English, preferably by a medical practitioner with experience in diving medicine, within 90 days prior to the commencement of training.

Recreational (including technical) diving - Workplace Health and Safety Queensland - Windows Internet Explorer

http://www.deir.qld.gov.au/workplace/subjects/diving/recreational/index.htm

Recreational (including technical) diving - Workp...

Queensland Government

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Workplace Health and Safety Queensland
Department of Justice and Attorney-General

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Diving

- [What law applies](#)
- [General hazards](#)
- [Recreational snorkelling](#)
 - [Managing the risks](#)
- [Head counts](#)
- [Medical fitness](#)
- [Supervision](#)
- [Instruction, advice and equipment](#)
- [Rescue and emergencies](#)
- [Snorkelling and moving vessels](#)
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 - [What is recreational diving?](#)
 - [What is recreational technical diving?](#)

Recreational (including technical) diving

[Home](#) > [Businesses](#) > [Industry sectors](#) > [Diving](#) > Recreational and technical

What is recreational diving?

Resort diving, learning to dive, qualified divers

What is recreational technical diving?

Includes EANx, EANx rebreathers, mixed gas, mixed gas rebreathers, decompression diving

Managing the risks

Risk assessment, headcounts, medical fitness, supervision, non-English speaking divers, equipment

Diving related illnesses and conditions

Flying after diving, barotrauma, nitrogen narcosis

Last updated 03 June 2010

Recreational diving resource kit

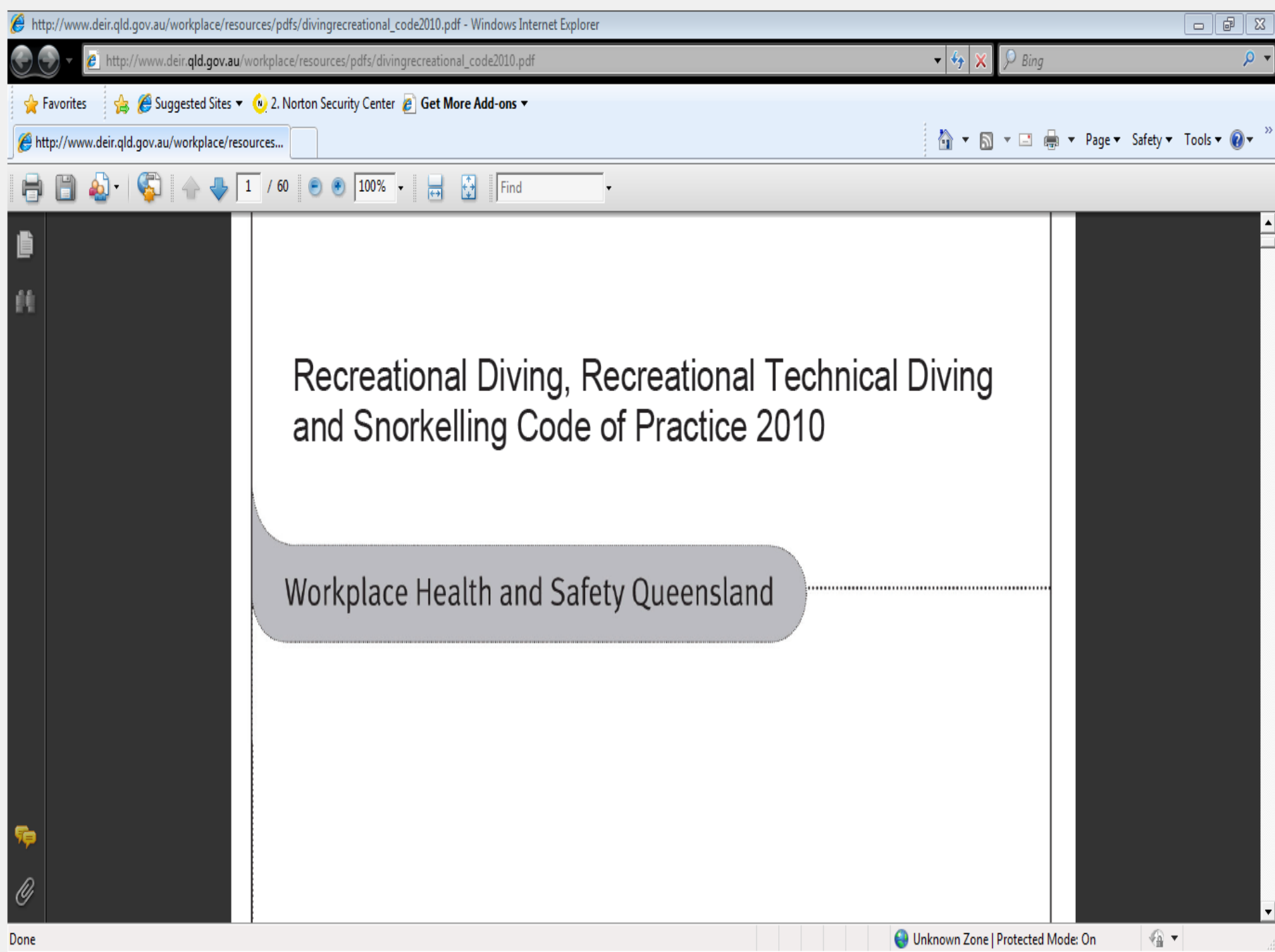
- [Dive safety log](#) (PDF, 133 kB)
- [Medical declaration form](#) (PDF, 81 kB)
- [Recreational diving and snorkelling compliance checklist](#) (PDF, 45 kB)
- [Safety information for SCUBA divers](#) (PDF, 364 kB)
- [Risk management process for the recreational dive industry](#) (PDF, 67 kB)

For more information contact:

- Queensland Government
 - [Dive Queensland](#) (Tourism Queensland)
- Non-Queensland Government
 - [Dive-Oz](#) (non-Queensland Government link) - one stop resource centre for

Done, but with errors on page.

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Recreational Diving, Recreational Technical Diving and Snorkelling Code of Practice 2010

Workplace Health and Safety Queensland

Recreational Diving, Recreational Technical Diving & Snorkelling COP 2010

2.3 Control measures for all recreational diving
and recreational technical diving

2.3.1 Medical fitness of diving workers

2.3.1.1 Medical fitness of resort divers

2.3.1.2 Medical fitness of entry-level certificate
divers certificate is certified as being medically

fit for diving in accordance with Appendices A

and B of AS 4005.1 – 2000

2.3.1.3 Medical fitness of certificated divers



Form 26

MEDICAL DECLARATION FOR RESORT DIVING

TO BE COMPLETED AND SIGNED BY RESORT DIVER

Personal details

Surname

Given Names

Address

Phone

Date of birth

/ /

Sex:

Male

Female

Have you suffered, or do you now suffer from, any of the following -

Yes

No

Asthma or wheezing

Brain, spinal cord or nervous disorder

Chest surgery

Chronic bronchitis or persistent chest complaint

Chronic sinus conditions

Collapsed lung (pneumothorax)

Diabetes mellitus (sugar diabetes)

Ear surgery

Epilepsy

Fainting, seizures or blackouts

Heart disease of any kind

Recurrent ear problems when flying

Tuberculosis or other long-term lung disease

Are you currently suffering from -

Yes

No

Breathlessness

Chronic ear discharge or infection

DOCUMENTED METHOD OF PROVIDING ADVICE ABOUT MEDICAL CONDITIONS TO PROSPECTIVE RECREATIONAL SNORKELLERS

Reference the Workplace Health and Safety Regulation 1997 Section 86I and the Compressed Air
Recreational Diving and Recreational Snorkelling Code of Practice 2005 Section 2.2.2

Medical Declaration - recreational snorkellers

I (*print name*) _____
declare that I have been advised snorkelling can be a strenuous physical activity and may increase the
health and safety risks to me if I am suffering from:

A. Any medical conditions that may be made worse by physical exertion.

For example heart disease, asthma, some lung complaints

B. Any medical condition that can result in loss of consciousness.

For example some forms of epilepsy and some diabetic conditions

C. Asthma that can be brought on by cold water or salt water mist

I have been advised that snorkelling can be a strenuous physical activity even in calm water and that
older persons are at an increased risk of death and injury due to a higher incidence of medical
conditions made worse by physical exertion, such as heart disease and stroke.

I have been advised to tell the lookout, snorkelling supervisor or snorkelling guide if I have any
concerns about a medical condition.

Signature _____ Date _____

Parent's or guardian's signature for minors _____

Note: It is recommended persons with a medical condition and older persons intending to snorkel
should:

**A. Snorkel in an area which allows the lookout or snorkelling supervisor
to offer closer supervision.**

B. Wear a flotation device that will support the wearer in a relaxed state.

C. Snorkel in a buddy pair



Contents of certificate of medical fitness to dive

- A certificate of medical fitness to dive must show its date of issue and the certificate holder's name.
 - If the certificate holder is at least 18, the certificate must also show that—
 - (a) the holder is medically fit to dive in accordance with the relevant fitness criteria; or
- 
- 
- 

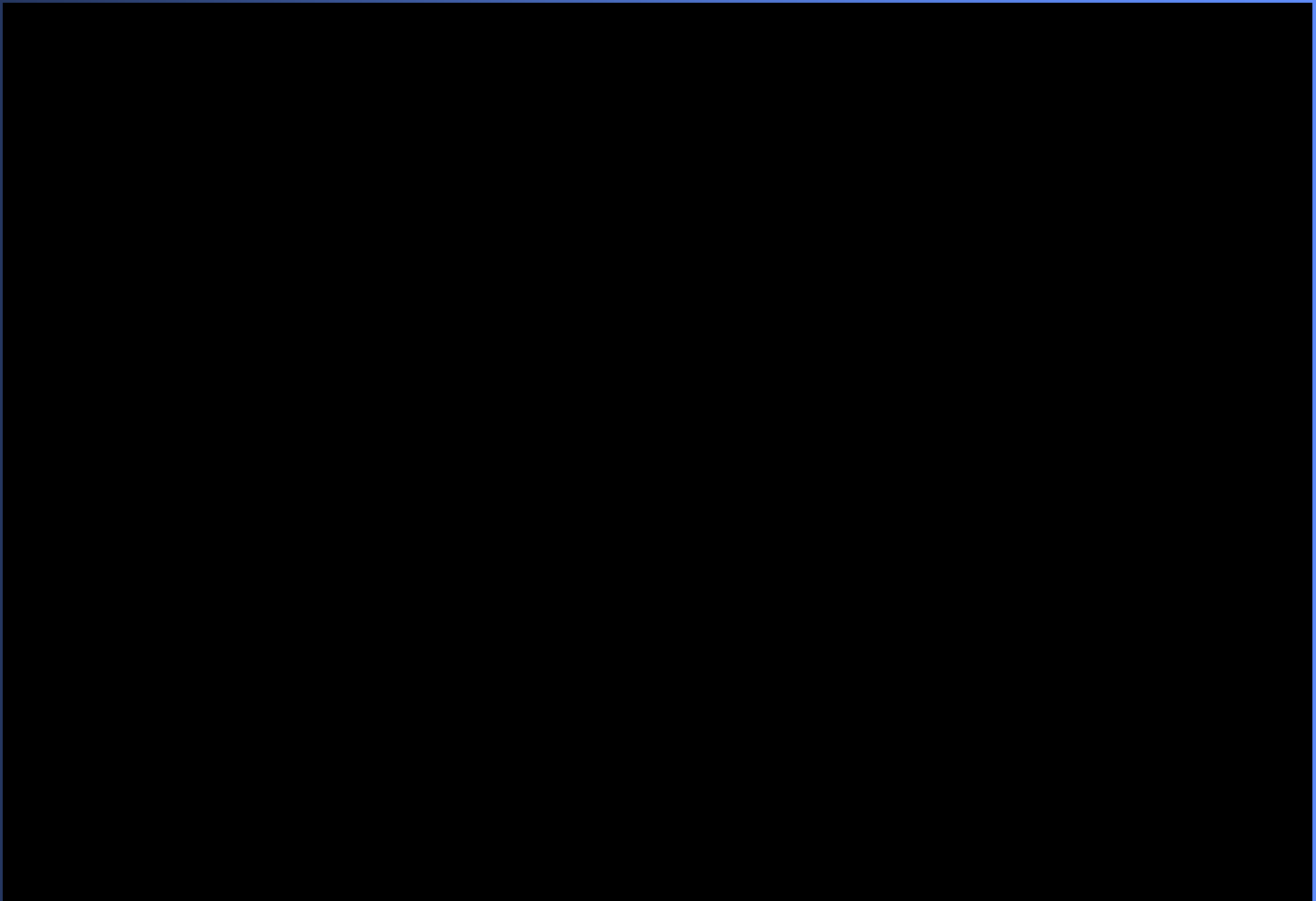
- b) subject to a limitation on diving stated in the certificate, the holder is medically fit to dive in accordance with the relevant fitness criteria.
- (3) If the certificate holder is under 18, and no limitations on diving are imposed on medical grounds, the certificate must also show that—
 - (a) apart from being under 18, the holder is medically fit to dive in accordance with the relevant fitness criteria; and
 - (b) no limitations on diving are needed even though the holder is under 18.

- 4) If the certificate holder is under 18, and limitations on diving are imposed on medical grounds, the certificate must also show—
 - (a) that subject to the limitations on diving stated in the certificate, the holder is medically fit to dive in accordance with the relevant fitness criteria; and
 - (b) any limitations imposed because the holder is under 18.
- (5) In this section— relevant fitness criteria means the fitness criteria stated in AS/NZS 2299, part 1, appendix M, paragraph M4

Fees

- \$45-70

Fitness to Dive



Compressed Air Diving

- SCUBA
- Technical Diving
- SSBA / Hookah
- Commercial Diving
- Scientific Diving



Submarines
Breath Hold Diving

Diving Physiology

- **Boyles law** $P \sim 1/V$ @ constant T or $P_1 V_1 = P_2 V_2$
- **Henrys Law** amount gas dissolved $\sim$ pressure gas over the liquid
- **Charles law** increasing T increases gas V @ constant P
- **Daltons law** $P_T = P_1 + P_2 + P_3 + P_4$
- **Pascals Principle** linear relationship between P & D underwater

Daltons law

- Air $78 \% \text{N}_2 + 21 \% \text{O}_2 + \text{traces CO, CO}_2, \text{Arg, Xe, Ne, Kyp}$
- Nitrox $\text{N}_2 + \text{O}_2$
- Heliox $\text{He} + \text{O}_2$
- Trigas $\text{He} + \text{O}_2 + \text{N}_2$
- Hydrox $\text{H}_2 + \text{O}_2$

Daltons Law

- Oxygen Toxicity
- Nitrogen narcosis 'narcs'

Surface = 1 ATA = 0.8 N₂ + 0.2 O₂

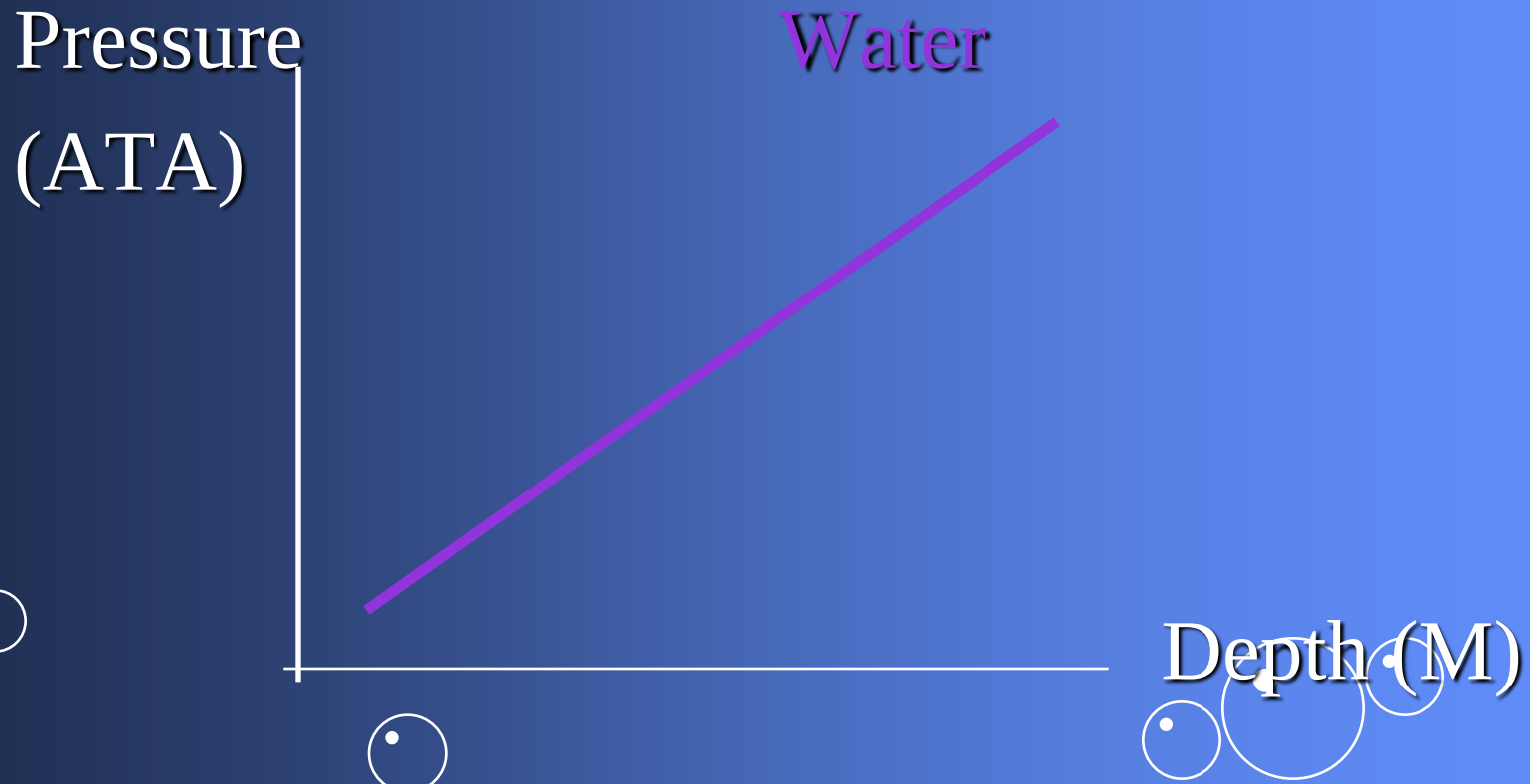
(pp O₂ = 1 ATA x 20% = 20%)

40 m = 5ATA = 4.0 N₂ + 1.0 O₂

(pp O₂ = 5 ATA x 0.20% = 100%)

Pascals principle

- 1ATA = 10 m sea water / 33 ft sea water / 34 feet fresh water / 1 bar / 760mmHg



Buoyancy

- Archimedes Principle



Temperature

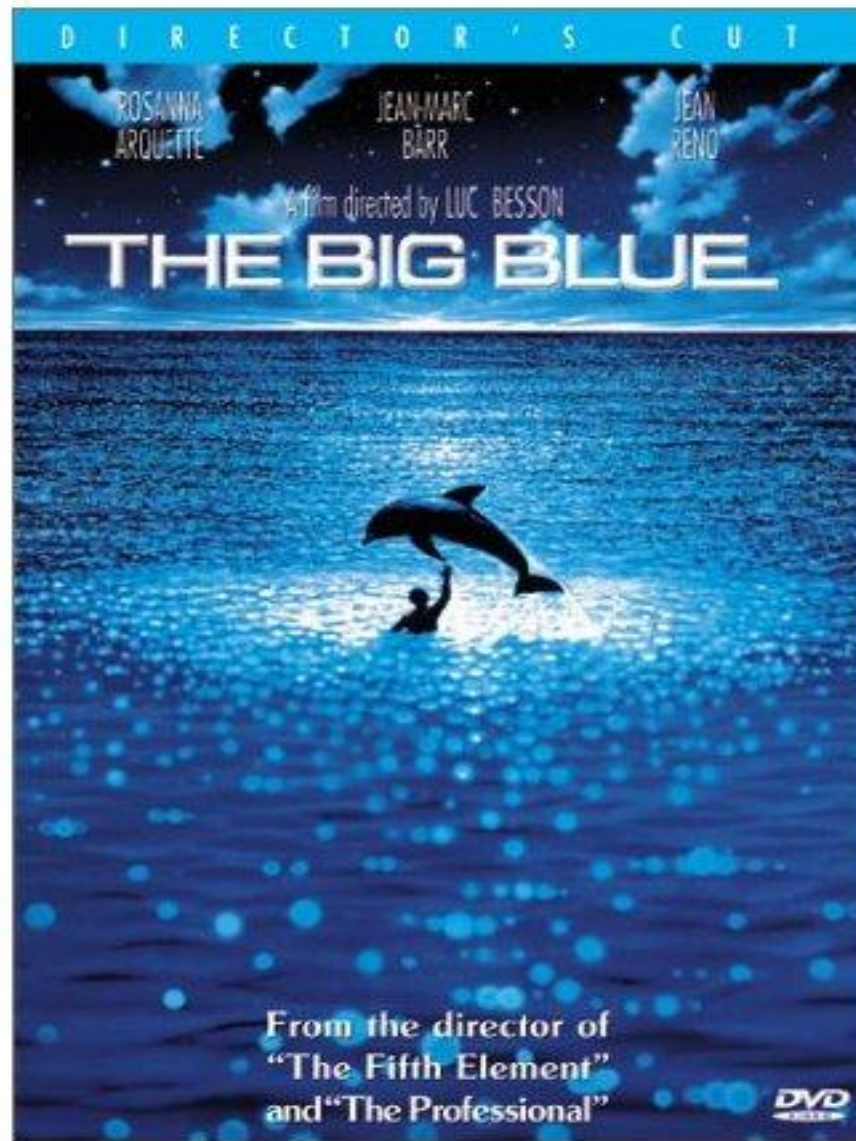
- Thermal Comfort Zone

Light & Colour

Sound

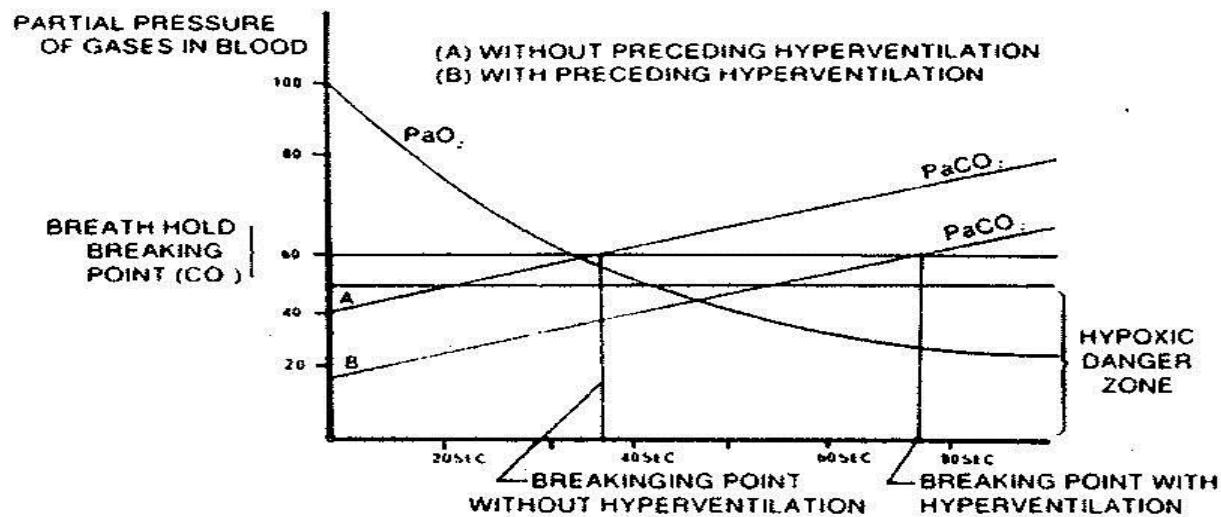
The Big Blue





Break Point

Figure 11. Breath-hold diving, and levels of arterial oxygen and carbon dioxide.

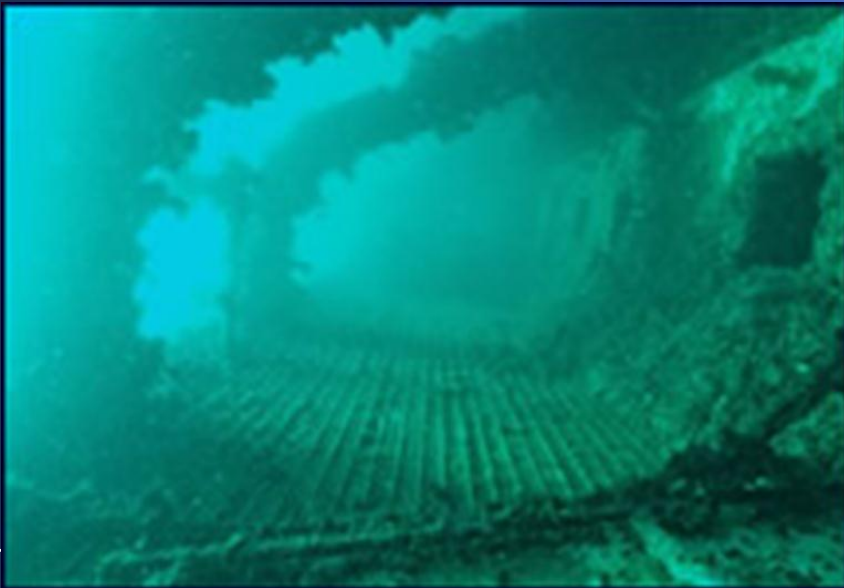


Mikhail Lermontov Disaster

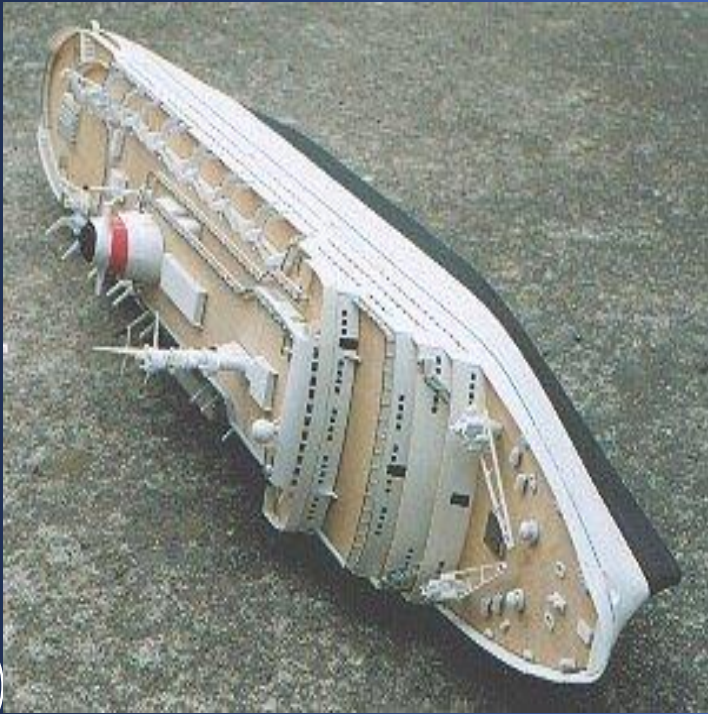
16 Feb 1986



Mikhail Lermontov 1996



Mikhail Lermontov Disaster



- The vessel lying in Port Gore in about 37 meters of water although this varies with the tide
- 10 degree slope
- The Port bridge wing is only about 12 meters below the surface.
- Bottom visibility varies greatly from 4-20m,







Standards Diving Medical Fitness

- Commercial AS/NZ 2299 Dept of Labour
 - Standards Australia - Recreational Diving
Medical 31.03.2000
- 

www.standards.com.au

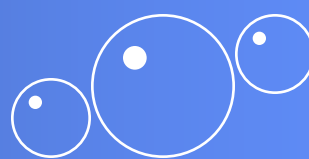
www.saiglobal.com

- 
- SPUMS Sport Diving Medical May 1999

www.spums.org.au



Code of Practice for Diving on Construction
Work 1987



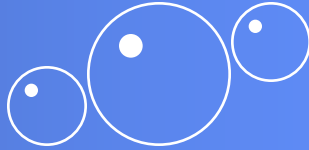
Dive Medicine Courses

- United States Navy Diving Medical Officer Course.
- Royal Adelaide Hospital Basic Course in Diving Medicine or the Advanced Course in Diving and Hyperbaric Medicine;
- Royal Australian Navy Submarine and Underwater Medicine Unit Basic Course, Advanced Course or Medical Officer's Course;
- Diving Medical Centre Medical Examiner Course;
- Fremantle Hospital Medical Assessment of Divers Course;
- Royal New Zealand Navy Basic Course;
- Christchurch Hospital Basic Course;
- Institute of Naval Medicine (UK) Medical Examiner Course



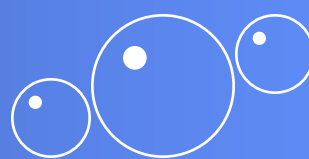
Standards Australia

www.standards.com.au

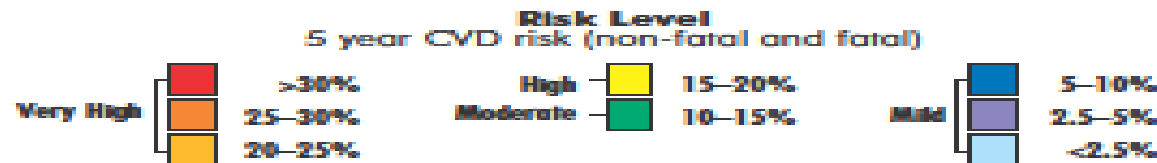
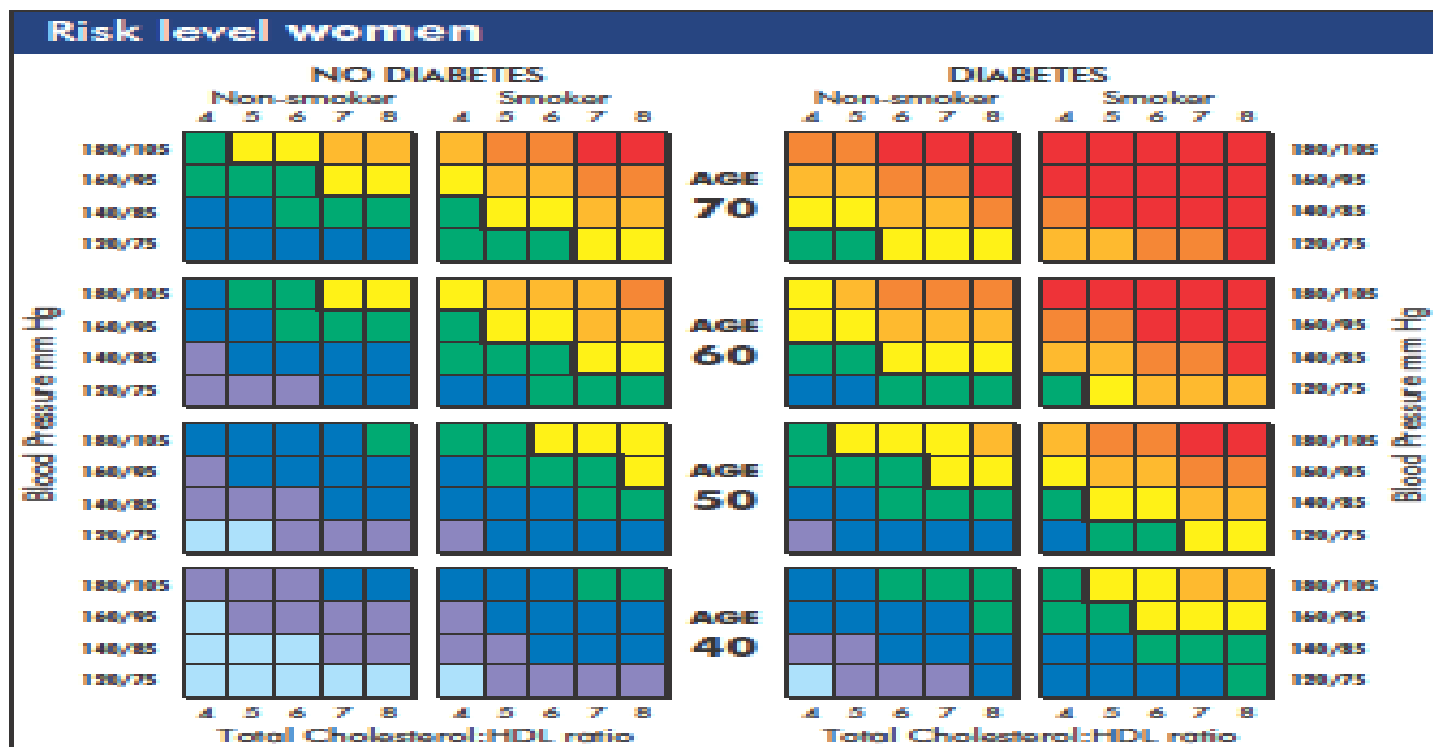
- Search using Australian Ref No 4005.1
 - Search results - \$38.70 per 50 copies
 - AS 4005.1-2000 training & certification of recreational divers - minimum entry -level SCUBA diving (H/C or PDF)
 - **AS 4005.1 Supp 1-2000** Medical form for prospective recreational SCUBA divers
 - **AS 4005.1 Supp 2 -2000** Statement of health for recreational diving
- 
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Sport Dive Medical

- History, Examination and Risk Assessment
 - Urinalysis
 - Spirometry
 - Audiogram ? Tympanogram
 - ? Chest x-ray
- 
- 
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NHF tables CV Risk Profile



How to use the Tables

- Identify the table relating to the person's sex, diabetic status, smoking history and age.
- Within the table choose the cell nearest to the person's age, blood pressure and TC:HDL ratio. When the systolic and diastolic values fall in different risk levels, the higher category applies.
- For example, the lower left cell contains all non-smokers without diabetes who are less than 45 years and have a TC:HDL ratio less than 4.5 and a blood pressure less than 130/80 mm Hg. People who fall exactly on a threshold between cells are placed in the cell indicating higher risk.

Risk Matrix Scuba Diving

Risk Matrix Scuba Diving						LIKELIHOOD						
						Historical:	"Unheard of in the industry"	"Has occurred once or twice in the industry"	"Has occurred many times in the industry, but not in the Company"	"Has occurred once or twice in the Company"	"Has occurred frequently in the Company"	"Has occurred frequently at the location"
						Frequency: (Continuous Operation)	Once every 10,000-100,000* years at location	Once every 1,000-10,000 years at location	Once every 100-1,000 years at location	Once every 10-100 years at location	Once every 1-10 years at location	More than once a year at location or continuously
						Probability: (Single activity)	1 in 100,000-1,000,000*	1 in 10,000-100,000	1 in 1,000-10,000	1 in 100-1,000	1 in 10-100	>1 in 10
							0	1	2	3	4	5
							Remote	Highly Unlikely	Unlikely	Possible	Quite Likely	Likely
CONSEQUENCE	>20 Fatalities (or Permanent Total Disabilities)	Regional scale (>100 km ²) Long term/permanent impact	>A\$1000M	International concern. Major ventures terminated. Company at stake.	A+	Catastrophic						
	4-20 Fatalities (or Permanent Total Disabilities)	Large scale (10-100 km ²) Long term (decades) impact	A\$100M-A\$1000M	Persistent national concern. Long term 'brand' impact. Major venture/asset operations severely restricted.	A	Massive					Severe 	
	1-3 Fatalities (or Permanent Total Disabilities)	Medium scale (1-10 km ²) Medium term (years) impact	A\$10M-A\$100M	Medium term national concern. Minor venture or minor asset operations restricted or curtailed.	B	Major			High			
	Major Injury/illness, Permanent Partial Disability or Lost Work Case >4days	Medium scale (1-10 km ²) Short term (months) impact	A\$1M-A\$10M	National bad mention. Short term regional concern. Close scrutiny of Asset level operations/future proposals.	C	Moderate		Medium				
	Minor Injury/illness. Restricted Work Case or Lost Work Case <4 days.	Localised (<1 km ²) Short term (weeks) impact	A\$100k-A\$1M	Short term local concern. Some impact on asset level non-production activities.	D	Minor						
	Slight Injury/illness. First Aid or Medical Treatment Case	Localised (Immediate area) Temporary impact (days)	<A\$100k	Local mention only. Quickly forgotten. Freedom to operate unaffected.	E	Slight		Low				



Medical Assessment Fitness to Dive

- Absolute & Relative Contraindications
- 



Decision Making

Fitness to Scuba Dive

1. Will the Medical Condition:

Get worse

Improve

Stay the same

Don't know = get advice

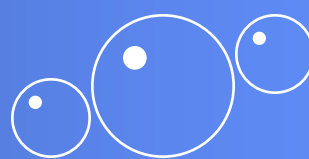


2. What are the Risks for

Barotrauma

Drowning

Bends/ CAGE





Asthma

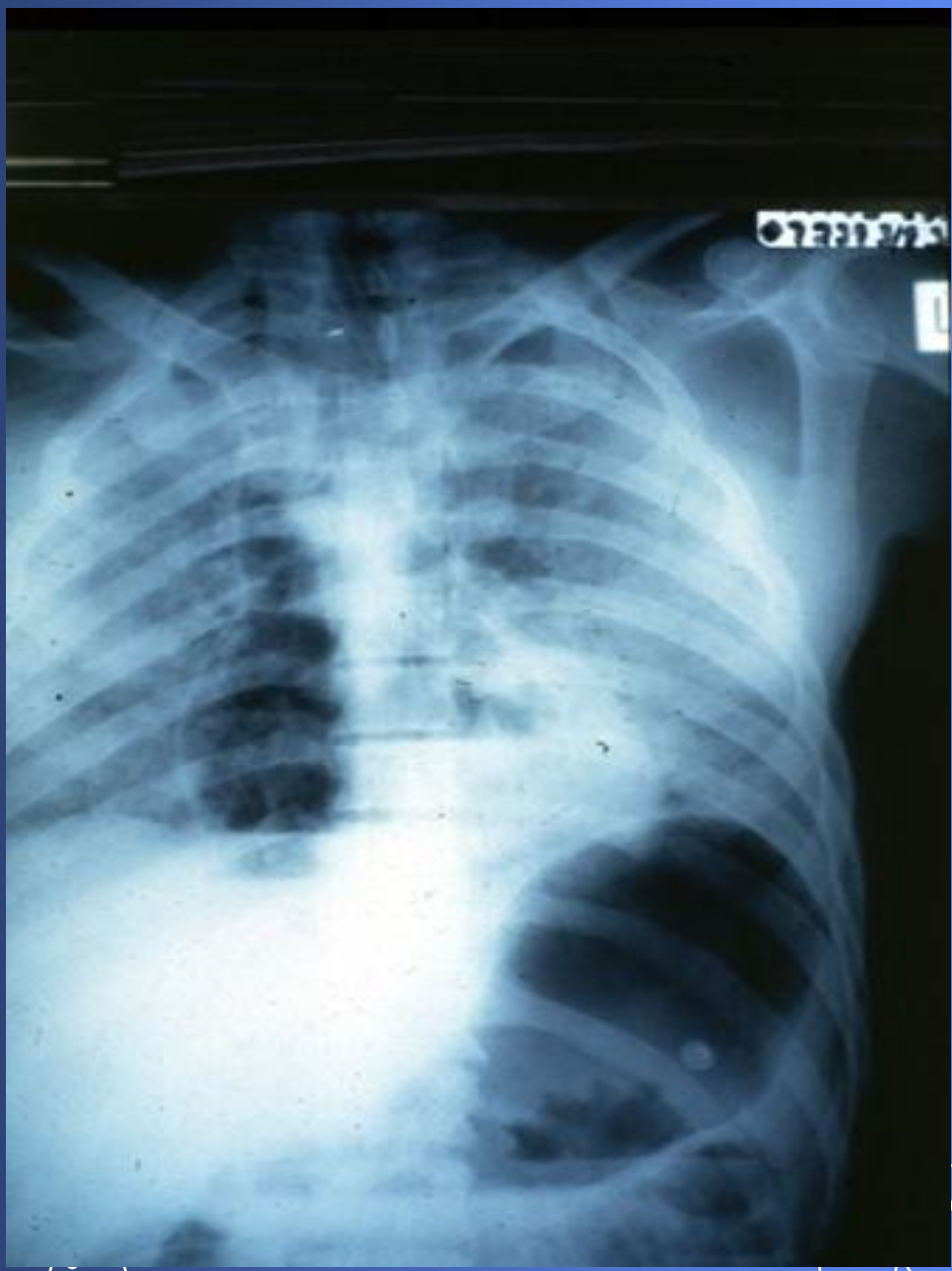
- 1) 20 year old female nurse with history of childhood hayfever and asthma.
Asymptomatic, no meds, normal spirometry.
 - 2) 40 year old female GP with asthma 25 years, on budesonide (800ug/day). No symptoms at present and last used salbutamol inhaler 6 months ago. Spirometry normal.
- 
- 



Asthma

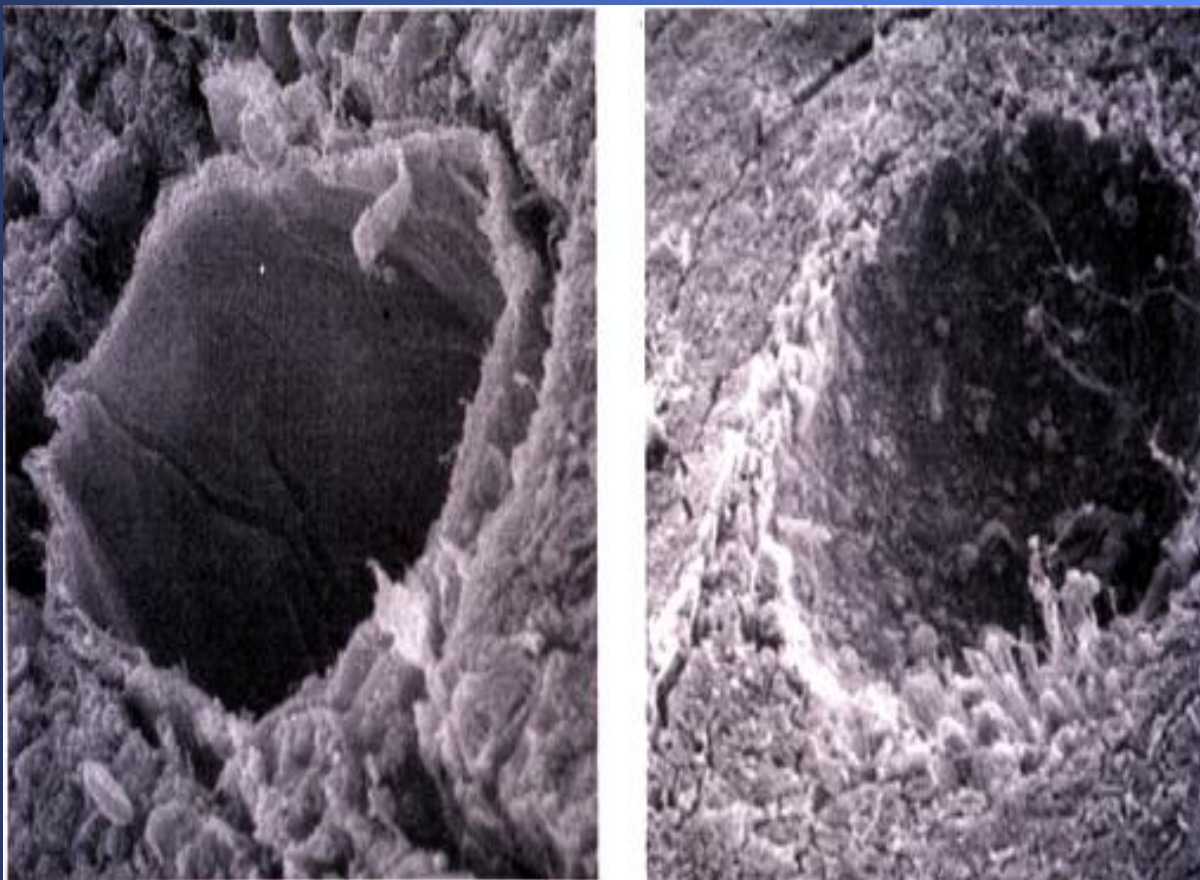
- Air trapping - CAGE
 - Not possible to medicate underwater
 - SCUBA air dry and may aggravate asthma
 - Salt water aspiration may trigger
 - Decompression treatment may aggravate asthma and complicate acute management
 - Risk for pneumothorax
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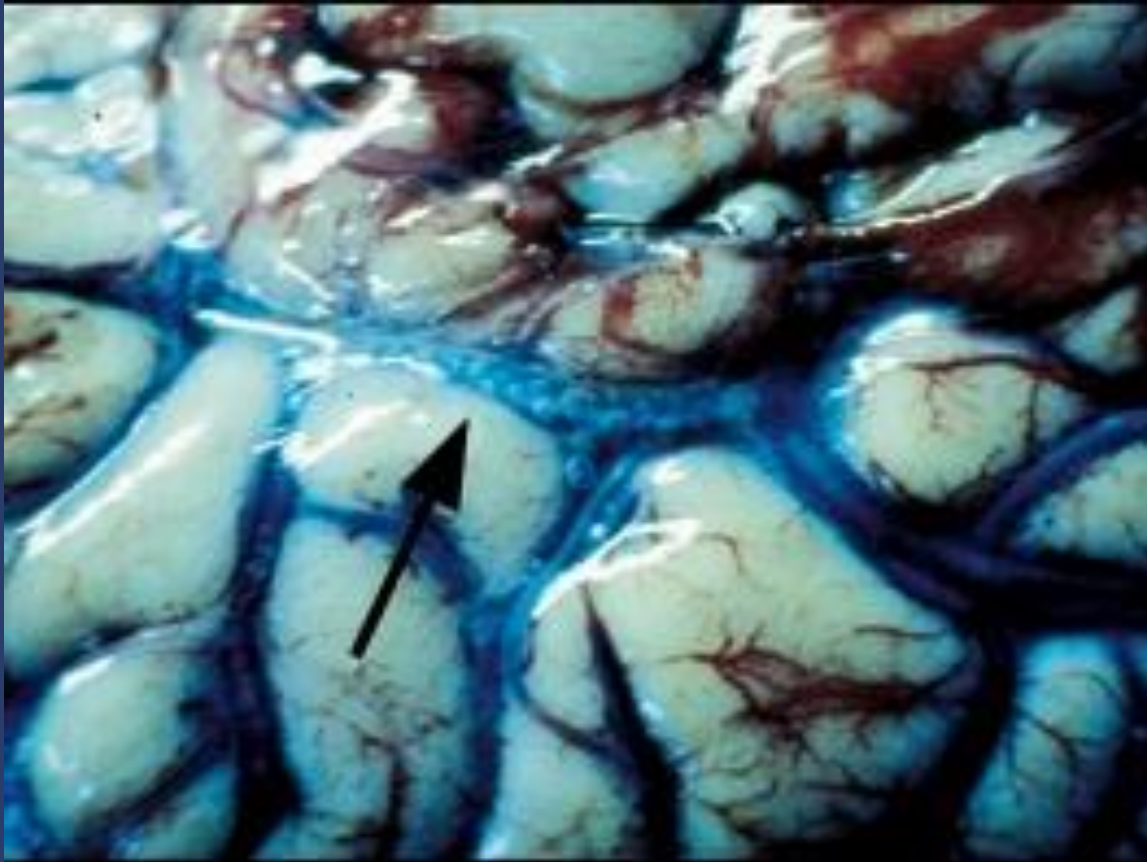




CAGE





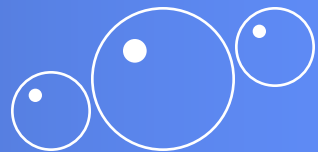




Requirements for Barotrauma

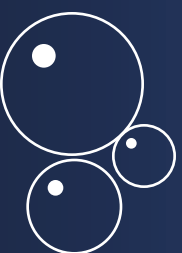
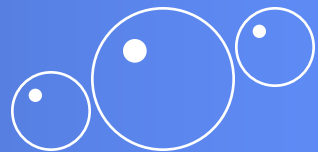
A space that is :-



- Gas filled
 - Rigid / stiff walls
 - Enclosed
 - Vascular penetration
 - Ambient pressure change
- 
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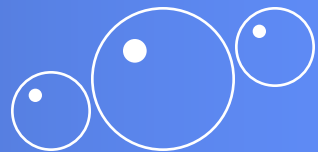


Medical Assessment Fitness to Dive

- Absolute & Relative Contraindications
 - Risks for Barotrauma
 - Risks for Drowning
 - Risks for Decompression
- 
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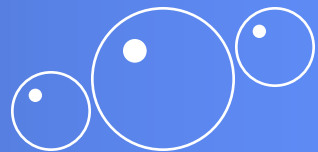


Risks for Barotrauma

- 
- Psychiatric conditions
 - Intellectual difficulties
 - Inability to autoinflate ears or sinuses
 - Previous middle ear, sinus or lung surgery
 - Previous lung disease e.g.pneumothorax
 - Lung cysts
 - FEV1/FVC <75%
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Risks for Barotrauma

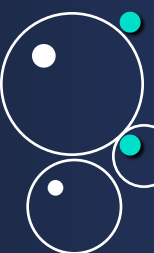
- Flow volume loops
 - Paradoxical embolism from R to L shunt
 - Laryngocoele
 - Post gastrectomy
 - Hiatus hernia
 - Nissan fundoplication
 - Abdominal or Thoracic hernia
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Risks for Drowning

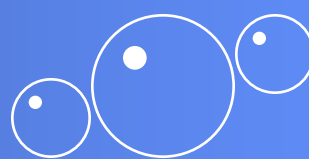
Any condition that may cause transient loss of consciousness:-



- Cardiac - long QT syndrome; IHD; pacemakers; warfarin; valvular heart disease
 - Drug abuse - THC; EtOH; Methadone
 - ENT - inner ear surgery; tracheostomy etc
 - Haematological - Sickle Cell disease etc
 - Metabolic - thyrotoxicosis; IDDM etc
 - Neurological - epilepsy; TIA; head injury etc
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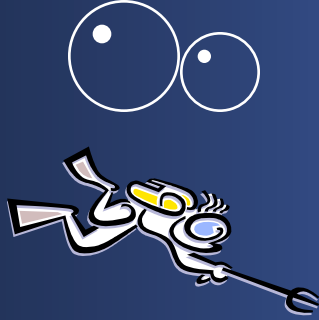
Risks for Drowning

- Psychiatric conditions
 - Intellectual difficulties
- 
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Risks for Decompression

- Age
 - Sex
 - Obesity
 - Smoking
 - Drugs - legal/illicit
 - Cardiac -PFO; R $\rightarrow$ L shunt
 - Neurologic - AVM
 - Pregnancy - no foetal decompression tables
- 
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Bends



- Bubble dynamics
- Off gassing
- Evolution
- Premorbid conditions
- Non diving vs diving related pathology
- Types 1,2 & 3

Barotrauma

- Cerebral Arterial Gas Embolism **CAGE**
- Middle Ear Barotaruma
- Inner Ear Barotrauma
- Sinus Barotrauma - pneumocephalus
- Tooth Barotrauma - aerodontalgia
- Chest Bartotrauma – pneumothorax / emphysema
- Gastrointestinal Barotrauma - pneumoperitoneum
- Diaphragmatic Rupture following Nissen Fundoplication for GORD

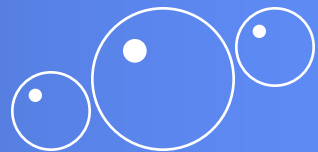
Br J Sports Med 1998 32:75-76 Hayden et al

Chest Trauma

- 54 yr old caucasian professional male
- March 2003 fall from mountain bike sustaining # left ribs 2-8, # left clavicle, L ACJ disruption & haemopneumothorax
- Initially triaged but represented 2/7 later requiring IC tube & drainage
- SCUBA 1996 ; 70 dives ; maxm 33 m
- FEV1 3.50 FVC 4.23 82 % Ht 1.76 m
- CXR 08.09.2003 old healing # 2-8 left. A little linear parenchymal scarring at left lung base.

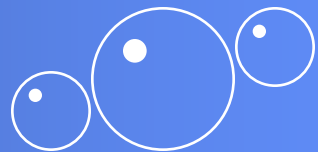


Chest Trauma

- Contiguous CT scan in inspiration and expiration recommended
 - **CT chest high resolution 16.01.2004** – very minor pleural & parenchymal scarring anteriorly at left base within the lingula and involving the adjacent oblique fissure (manifest by several parenchymal bands and minor thickening of the inferior oblique fissure). No air trapping.
 - 10.03.2004 – two easy dives 15-16 m cray fish hunting. No problems.
 - Risks explained.
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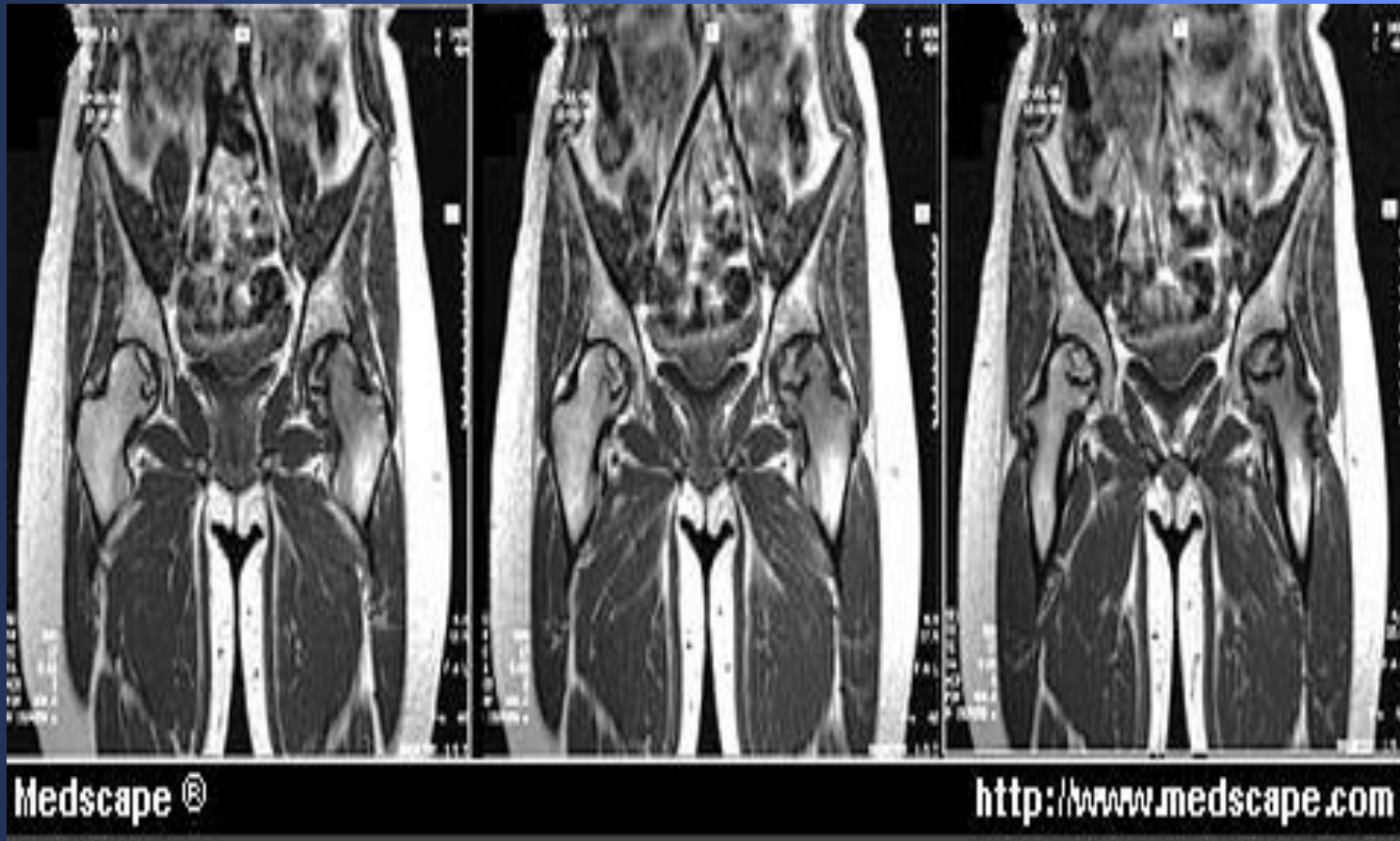
Pulmonary Edema of Diving

- Immersion related; etiology unknown
 - Cough, SOB, haemoptysis on bottom or during ascent
 - Intermittent
 - Spontaneous resolution over 24 hours
 - Precipitating factors – preload & afterload e.g. heavy exercise; -ve pressure breathing; pre-dive fluid overload
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Cutis Marmorata



Dysbaric Osteoradionecrosis



Preliminary management

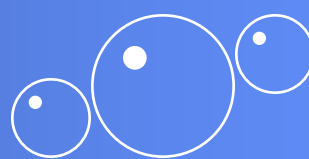


Links

- **DAN** www.diversalertnetwork.org
- **SPUMS** www.spums.org.au
- **UHMS** www.uhms.org
- **HTNA** www.htna.com.au
- Not recommended - www.uksdmc.co.uk

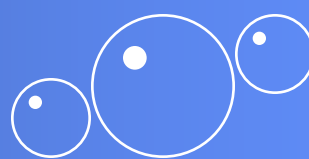


Case 1

- 11 year old boy presents with his mother for a dive medical as the family are going on a holiday to Fiji and both parents are keen scuba divers.
 - History of grommet surgery both ears when he was 5 otherwise OK
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Case 2

- 16 year old school girl is doing a diving course in Year 11.
 - Possibly interested in a career as a Marine Biologist
 - History of asthma until age 12 then free of symptoms
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Case 3

- 55 year old UK executive on holiday with family wants to do SCUBA diving on Hamilton Island
- CAVG surgery eight months ago x 4 grafts

Case 3

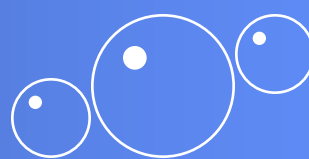
- Ignores your advice that he is not suitable for sport scuba diving following a strongly positive post CAVG surgery stress exercise test
- Finds a GP who signs him off as “*fit for shallow diving only*” (not > 60 feet/20 metres)
- Found unconscious floating in water off Hamilton island. CPR unsuccessful.
- Coroners Court requests a copy of your medical records

Case 4

- Epileptic well controlled on carbamazepine for 20 years with no history of seizure for 19 years
- Drives a commercial truck



Case 5

- 19 year old male with recent head injury following cycle accident 6 months ago. Admitted to hospital for observation for 3 days. GCS 12 on admission.
 - Six weeks recovery and still has intermittent headaches
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Case 6

- 21 year old female with recent head injury following MVA 12 months ago. Admitted to hospital for observation for 2 days.
- GCS 13 on admission. CT Head scan showed diffuse frontal lobe petechial haemorrhages.
- Remarkably quick recovery & back at work as an administrator after 14 days

Case 7

- 22 year old female with history of multiple relapses for bipolar disorder
- Lithium medication

Case 8

- 24 year old male with Paranoid Schizophrenia on olanzapine

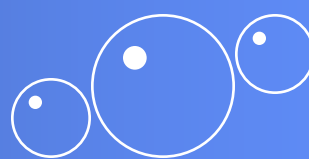
Case 9

- 25 year old paraplegic male T12
- Paraplegia a result of fall at work two years ago and burst # T12/L1
- Wheelchair bound
- Para-olympian Basketball player

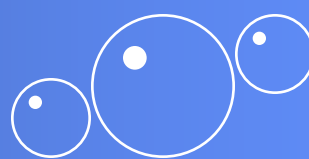


Case 10



- 45 year old male
 - BP 150/100
 - Cholesterol 6.30 ; HDL 0.79 ; Chol/HDL ratio 8
 - BMI 32
 - Non smoker
 - Brother age 35 heart attack
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- Dr X issues a conditional medical certificate stating:

- *“ To Whom it May Concern: This is to certify that I have examined this man today. He has untreated hypertension and is awaiting cardiologist assessment atHospital which is scheduled for I feel he is fit to do the basic PADI course in a pool but should defer sea diving until clearance by his Cardiologist has been obtained.”*
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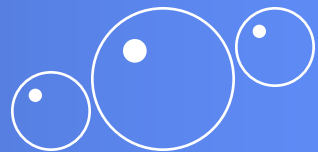
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- There is no indication that the reviewing Cardiologist was contacted to request an opinion on Diving Medical fitness.
 - The PADI medical statement signed by Dr X (and later the usual GP) says in the preamble:

“To scuba dive safely you must not be extremely overweight or out of condition. Diving can be strenuous under certain conditions. Your respiratory and circulatory systems must be in good health.”



PADI warning statement

“A person with heart trouble, a current cold or congestion, epilepsy, asthma, a severe medical problem, or who is under the influence of alcohol or drugs should not dive. If taking medication, consult your Doctor and the instructor before participation in this program.”





Cardiologist Letter

- Dr P (registrar to Dr M consultant Cardiologist)
 - Echocardiogram normal.
 - Started Mr X on treatment (accupril) for his high blood pressure.
 - Screening stress exercise test was not undertaken, as Mr X had no symptoms of heart disease. No mention of SCUBA diving in the correspondence
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