Medical Aspects of Diving in the Offshore Oil Industry

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Chairman, Diving Medical Advisory Committee
What is diving?

- Diving = Commuting
  - Offshore (oil field) engineers
  - Archaeologists and scientists
  - Inshore engineers
  - Police
  - Media
  - Windfarm
  - (Recreational)
Problems for divers

• Water
  breathing apparatus – cold - dense
• Pressure
  barotrauma - decompression illness
• Gas properties
  narcosis and density
  helium - thermal conductivity
• Buoyancy
  weightlessness
## Diving – breathing underwater

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<th>Pressure ata</th>
<th>Volume litres</th>
<th>Density grams/litre</th>
<th>MVV litres/min</th>
<th>pN2 ata</th>
<th>pO2 ata</th>
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Barotrauma

- Gas containing spaces in the body will change in volume with pressure change
  - Middle ear
  - Lung
  - Gut
  - (suit and mask)
Decompression

- Inert gas dissolves in body tissues while breathing gas at increased pressure.
- On ascent the extra gas has to be removed from the body - fast ascent may produce bubbles - slow ascent allows safe release of excess gas.
- The deeper you go and the longer you stay the more gas dissolves - until equilibrium (6-8hrs).
- Time required for safe decompression increases with amount of excess gas - until equilibrium (saturation).
Surface oriented mixed gas dive

Duration of dive (mins)
Saturation Diving

- Store divers at pressure close to their work

- Transport them to worksite each day (no pressure change - so no limitation on shift time - usually 6-8hrs)

- After period of work (21 days) do one long decompression (5-7 days)

- Efficient and effective use of diver time, plant and equipment

- Safe and pays well
Saturation dive

Dive duration (hours)
What are the problems?

- Isolation - 7 days from surface. Medical events have to be managed while in chamber.
- Thermal control - narrow band of comfort
- Humidity
- Hygiene - infections are common
- Toxic environment - living in recirculated gas which accumulates contaminants
Capita Diving Services

- Routine medical advice
  - Procedures
  - Incident investigation
- Assessment of divers fitness
  - Routine
  - After accident, illness or injury
- Emergency medical service
  - Immediate access to medical advice (telephone)
  - Mobilisation of medical staff / equipment to dive site
  - Integration of remote medical care with normal health care systems (NHS)
Routine Advice

- Regimes for treatment of decompression illness
- Methodology for shallow saturation diving
- Suitable medical equipment
- Medical dispensation re regulations
- Incident?
Medical Fitness

- HSE requirement
- Conducted by AMEDs
- Guidance document MA1
  - assessment of physical fitness
    - Chester step test
  - coronary arterial disease
    - Guidance suggests successful PCI acceptable
    - ? Future risk
    - ? Implications for any event in saturation
Emergency Services

• Dive Supervisor has overall responsibility for the health and safety of divers
• Medical support provides advice to the supervisor on medical management
• In an emergency supervisors need
  – Immediate access to medical advice
  – Advice from doctors knowledgeable about the diving environment
  – Uncritical, friendly, helpful and supportive advice
Case 1
Case 2

- 43 yr old saturation diver (Storage depth 75msw)
- Makes one dive excursion to 92msw
- 14 hrs later wakes with double vision, ataxia and weakness in left arm
- Supervisor considers diagnosis of decompression illness and compresses diver and starts treatment regime and seeks medical advice
- Some improvement – continues treatment
- 12 hrs later still significant symptoms
Case 2

- Assessment / examination in chamber by another diver
  - Symptoms
    - Double vision, clumsy left arm, unsteady
  - Signs
    - Weak left arm
    - Unable to stand with eyes closed
    - Abnormal eye movements - on looking to left, right eye remains looking straight ahead
Case 2

• Dilemma
• ? Decompression illness = requires further recompression therapy i.e. longer in chamber
• ? CVA = decompress and arrange hospital assessment ASAP
Case 3
25 old commercial air diver

- 22.14 left surface - photographic survey dive
- 22.17 left tender at 5 msw
- 22.20 arrived 46 msw
- 22.22 reported in difficulty
- 22.24 no communication
- 22.25 standby diver descends: gas switched
- 22.30 unconscious - free flow - ascent
- 22.39 starts talking at 14 msw
- 22.41 on surface - helmet off - falls over
- 22.46 at 50 msw in chamber - headache
Possible causes of loss of consciousness

- hypoxia - loss of gas or wrong gas
- contaminant - CO
- hypocapnia - hyperventilation / panic
- hyperoxia - ppO₂ > 1.2 ata
- other medical causes
- hypercapnia - dead space, gas density
Case 4

- 44 yr old diver in saturation depth 25msw
- Doctor called and given the following history
  - Sudden onset of nausea lasting 30 minutes terminated by episode of violent and profuse vomiting. Traces of blood noted in vomit.
  - Diver now on entirely well - vital signs normal
  - No other diver affected.
  - Advice - uncertain cause. Plan keep diver on bunk, oral fluids only, reassess after 12 hours
Case 4

• 6hrs later (4.00am) diver needs toilet, sits on bunk and is observed to have grand mal convulsion

• Doctor called
  – diver has recovered completely, now back on bunk, feels well, looks well, vital signs normal
  – Cause uncertain - needs assessment onshore
  – Plan - commence decompression, monitor closely
Case 4

• Company calls at 08.30 - any ideas?
• Diagnosis = probable major GI bleed
  – Blood in vomit
  – Normal pulse and BP (fit, 40s and lying down)
  – Not shocked warm skin (chamber temperature 29)
  – Hypovolaemia results in acute hypotension and convulsion when sitting
• Plan - keep horizontal, iv fluids, doctor to site, take O negative blood
Case 4

- Divers don’t put up drip
- Doctor arrives – diver appears well
- Chamber close to surface – supervisor won’t let doctor into chamber “will be on surface in 3 hours”
- On surface – diver appears well – but supervisor will not allow diver off vessel until completion of “bend watch” i.e. 12 hrs
- Compromise: doctor puts drip up and supervisor allows evacuation to hospital with a recompression chamber
- Arrives at hospital 20 hrs after vomiting – Hb = 4.8gm
- Receives appropriate resuscitation and investigation
Conclusions

• Diving Medicine = normal medicine with additional dimension of pressure
• Specific diving illnesses (now rare)
• Limited experience/evidence base
  – Poor algorithms
• Need to understand and manage problems from basic physiological/pathological principles