HKCEM JCM Case Presentation

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A diver's nightmare

Case History

■ M/40 Mainland professional scuba diver involved in marine sewage clearance Working at ~ 20 m under water Sudden fear, viewing 'ghost' shadows Ascended to water level by releasing the lead belt

Case presentation

LOC x 1-2 min
 Confusion (transient)
 Followed by severe left chest pain, left upper arm and left lower limb pain
 Transported by GFS to AED

Any diagnosis ??

Vitals

GCS 15/15
BP 154/104
Pulse 109/min
Pupils 3 mm +
Temp 36.6 °C
SpO₂ 96 % on 100 % O₂

Findings

Screaming in pain
Åir entry in Lt lung
Muscle spasm with swelling at Lt arm and Lt thigh, Lt hip ext. rotated
Abd: guarding in epigastrium

AED MX

100 % O2 with face mask Morphine 3 mg + 3 mg IV for pain Pain improved, muscle spasm subsided ECG: SR 115/min, no ST changes Blood taking ■ XR Lt arm & pelvis: no # \blacksquare CXR \rightarrow



AED MX

Urgent Surgical & ICU consultations
 Left chest drain inserted

■ Foley \rightarrow dark red urine

Any DDx ??

AED MX

Blood results: ■ pH 7.248 ■ HCO3 17.5 ■ CK > 20000 Mx for rhabdomyolysis Forced diuresis ■ NaHCO3 Admitted to ICU

Ix & progress in ICU

 $\blacksquare \rightarrow Rt UL$ weakness (2/5), 2-3 hrs after adm Ix in X-Ray Dept: Urgent water soluble swallow ■ No rupture of oesophagus Urgent CT abdomen & pelvis Bilateral Ptx, Pm & Pp Urgent CT brain & C-spine Suspicious Lt high parietal hypodense spot

Progress in ICU

Also mild Rt apical pneuomothorax
 Rt chest drain also inserted
 MRI of brain was done 2/7 later

MRI of brain



Mx in ICU

Prophylactic myringotomies done
 Recompression therapy in Stonecutters island

- 4 sessions each 6 hrs, using Royal Navy Table 62
- Transferred to surgical ward

Outcome

Pneumothorax subsided
Tolerated oral intake
Rt UL power improved to grade 4
Home to China with referral on Day 11

Summary

Scuba diving emergency

- 1. Barotrauma: bilateral pneumothorax, pneumomediastinum, pneumoperitoneum
- Decompression illness: multiple limb pain, muscle spasm → metabolic acidosis, rhabdomyolysis; cerebral gas embolism → CVA with Rt hemiplegia

SCUBA diving versus diving

Scuba diving

Act of swimming underwater by use of SCUBA

- SCUBA:
 - Self
 - Contained
 - Underwater
 - Breathing
 - Apparatus

Diving

- Act of jumping or falling into water from a platform or springboard of a certain height
- Olympic games

Terminology

Decompression illness (DCI) Decompression sickness (DCS) Caisson disease The Bends The Diver's disease Arterial gas embolism (AGE) \square DCI = DCS + AGE

Pathophysiology of DCS

Main cause is a reduction in the pressure surrounding the body
 Common ways in which DCS occurred are:

 leaving a high atmospheric pressure environment
 ascent through water during a dive
 ascent to altitude in the atmosphere, e.g. flying in unpressurized aircraft

DCS vs AGE

<u>DCS</u>

- Formation of bubbles in multiple areas (soft tissues): joints, muscles, skin
- As a interface, triggering inflammatory (complement & coagulation) cascade
- $\blacksquare \rightarrow$ severe pain

<u>AGE</u>

- Formation of bubbles in arterial circulation
- \bullet \rightarrow infarction:
 - Stroke
 - AMI
 - Circulatory shock, sudden death

Clinical presentations of DCS

Symptoms depend on
Depth of dive (10 m = 1 bar)
Duration of exposure (bottom time)
Inert gas breathed (usu. N2)
Adequacy of decompression (rate of ascent)
Delay of presentation

Types of DCS

Type I (pain only)

Joint pain (bends)
Skin (skin bends) + lymphatic

Type II (serious)

- Pulmonary symptoms (chokes)
- Neurological symptoms

■ <u>Type III</u>

 Combination of DCS with neurological symptoms & arterial gas embolism (described by Bove & Neumann)

Type I DCS: Joint pain (the bends)

- 60 70% of all DCS cases
- Super-saturation of an inert gas within poorly perfused peri-articular tight connective tissue
- Deep, poorly localized pain
- Shoulder > elbow> hip > knee
- Diagnostic manoeuver BP cuff inflated to 150 – 250 mm Hg, ↓ pain temporarily

Type I DCS: Skin bends

10-15% of all DCS
 Mottled or marbled skin appearance

Itchiness in ear, face, neck, arms, upper torso

Sensation of insect crawling over the skin

Lymphatics

- Regional lymphoedema
- Painless pitting edema (swelling of the skin, with tiny scar-like skin depressions)

Type II DCS

Pain reported in only ~ 30%
\$/\$ variable and diverse
\$ymptom onset usually immediate, but may delay as long as 36 hrs
Involves:

CNS (spinal cord + brain)
Peripheral nerves

Type II DCS: Spinal cord

Most common neurological symptoms
Mimic spinal cord trauma
Abd, low back, lower limb pain
Paresis, paresthesia, paralysis, loss of sphincter control

Type II DCS: Brain

- Unexplained extreme fatigue or behavior change
- Dizziness, headache, confusion, memory loss
- Spots in visual field (scotoma), tunnel vision, diplopia, or blurry vision
- Seizure, unconsciousness
- Labyrinthitis → nausea, vomiting, vertigo

Type II DCS: Peripheral nerves

Urinary and faecal incontinence
 Muscle weakness / twitching
 Numbness, paresthesia

Type II DCS: Lungs (the chokes)

Burning substernal discomfort on inspiration
Pleuritic pain
Dyspnoea
Non-productive cough

Arterial gas embolism (AGE)

From 3 sources:

- 1. Venous gas embolism with breach of pul. vascular filter (paradoxic gas embolism)
- 2. Patent foramen ovale (paradoxic gas embolism)
- 3. Tear of the pul. parenchyma with entry of gas into pul. venous outflow (pul. overpressure syn. or burst lung) (usu. ass. with Ptx, Pm)

Management

ABC
IV morphine for pain control
100 % oxygen
Ix: blood and imaging
Blood: for acidosis, rhabdomyolysis
Imaging: for barotrauma: Ptx, Pm, Pp

Management for DCS

Other nonspecific treatments

 Drugs:
 NaHCO3 for rhabdomyolysis, metabolic acidosis
 aspirin
 steroid, e.g. methylprednisolone

 Specific Tx for DCS/AGE

 HBO

Hyperbaric oxygen (HBO)

1662, British physician Henshaw seems to have used compressed air for medical purpose

1775, Joseph Priestly discovered oxygen

1917, Drager proposed a system for treating diving accident victims using HBO

1937, Behnke and Shaw use HBO for DCS

Goals of HBO for Recompression

Three primary goals:

- 1. To compress gas bubbles to a small diameter and volume thereby reviving blood flow
- 2. T blood oxygen content & thereby oxygen circulation to the tissues
- 3. To allow time for bubble resorption (gradual recompression)

HBO – recompression chamber

Multi vs Mono Placed Chambes

MULTI-PLACED CHAMBER	MONO-PLACED CHAMBER
6 + ATA Limi good for AGE	3 ATA Limit
Room for attendant	No 100m for attendant
Large lock	No personnel lock
Extended treatment	Short treatments
Pressurized with air	Pressurized with oxygen
Separate O2 delivery	

Many people believe that by recompressing a victim to 33 feet or 2 ATA, they have diminished the size of any gas bubbles by one half.

Ref: Website: National Association of Rescue Divers

HBO - Contraindications

- Absolute untreated pneumothorax
 Relative -
 - Hx of spont. pneumothorax, chest surgery, ear surgery, central line placement
 - Claustrophobia
 - COAD, pregnancy, epilepsy
 - Doxorubicin, cis-platinum, bleomycin Tx, causing more significant toxic effect
 - Steroid, amphetamine, insulin, thyroid hormone, may 1 CNS toxicity, e.g. seizures

HBO - Complications / risks

- Barotrauma: middle ear, sinus, teeth, rarely tracheobronchial tree, GI tract
- Acute CNS O₂ toxicity, rare at < 3 atm</p>
- N+V, seizures, visual changes, vertigo, tinnitus
- Pulmonary O₂ toxicity, may begin after 6 hrs of breathing at 2 atm
- Dry cough, bronchitis, pul. fibrosis, pul. Edema
- Fire hazard

Recompression treatment in HK

1. HK Government Recompression Tx Centre

 Asia Hyperbaric Cente (private) located in Wong Chuk Hang (contact Dr. Ronson Li)

Hong Kong Government Recompression Treatment Centre

 located at Stonecutters Island (员船洲)
 consists of two multiplace chambers linked by an antechamber
 manufactured by Haux of Germany in 1994
 operated by Hong Kong Fire Services Department with responsible Medical Officer from Occupational Medicine Unit of Labour Department of Hong Kong





Emergency Recompression Tx

Emergency recompression Tx requires:

- 1. Consultation from A&E or other departments
- 2. Confirmed diagnosis of decompression illness
- 3. Contact with FSD by phone
- 4. Transportation of pt by ambulance
- 5. Mobilization of the doctor `on-call' at the Labour Department for a treatment decision

References

 Useful Websites:

 Wikipedia
 Answers.com
 Scubadoc's Diving Medicine Online: www.scuba-doc.com
 National Association of Rescue Divers
 Emedicine.com

THANK YOU

