Decompression sickness
- Pathophysiology
of diving accidents

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Diving accidents

**DCS** (Decompression sickness) after long and deep dives

**AGE** (Arterial gas embolism) after rapid ascents to the surface

**DCI** (Decompression injuries)
DCS
Decompression sickness
Henry‘s gas law

“Gases solve in liquids proportional to pressure“
Henry’s gas law

„Gases solve in liquids proportional to pressure“
Saturation
tissues load up with nitrogen ($N_2$)
Desaturation
tissues get rid of nitrogen ($N_2$)
Saturation
Different tissues need different time to load nitrogen ($N_2$)
Desaturation
Different tissues need different time to get rid of nitrogen ($N_2$)
Decompression tables & computers
Calculation of safe decompression procedures
Bubble formation in venous blood during & after decompression
Bubble growth
as long as venous blood is over-saturated with nitrogen ($N_2$)
Venous bubbles
• may stop local circulation
• cause tissue hypoxia
Venous bubbles

- may stop local circulation
- cause tissue hypoxia
- cause cellular death

Courtesy of UHMS
Shunts allow **venous** blood
- with dissolved nitrogen
- with nitrogen **bubbles**
to **arterialize**
Blood shunting in the lung when venous gas bubbles occlude lung capillaries.
**PFO**
Patent foramen ovale (~30%)

**R-L Shunt** possible when right atrium pressure increases
Shunts allow **venous** blood
- with dissolved nitrogen
- with nitrogen **bubbles**
  to **arterialize**
Shunts allow venous blood with nitrogen bubbles to arterialize.
Bubbles in functional terminal arteries

- endothelial irritation
- inflammation
- edema
- circulation stop
- tissue hypoxia
- cellular death

From: Muth CM & Shank ES. NEJM 2000;342:476-482
Bubbles in neurological tissues cause loss of function according to affected region.
Possible symptoms of nitrogen bubbles

- Discolouration and alteration of the skin
- Pain
- Tingling
- Physical weakness
- Numbness
- Paralysis
- Breathing difficulties
- Vision, hearing or speech disturbance
- Vertigo
- Nausea
- Impaired consciousness
AGE
Arterial Gas Embolism
Boyle’s gas law
Barotrauma of the lungs

Risk factors:
- obstructive lung diseases
- bullae
- tuberculosis

No risk:
- < 2 m depth

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Barotrauma of the lungs
Risk factor: bullae
Barotrauma of the lungs resulting in: pneumothorax
Barotrauma of the lungs resulting in: mediastinal emphysema
Barotrauma of the lungs resulting in: arterial gas embolism
Arterial gas embolism

- endothelial irritation
- inflammation
- edema
- circulation stop
- tissue hypoxia
- cellular death
Venous DCS bubbles & arterialised DCS bubbles & AGE bubbles may cause similar problems

- Discolouration and alteration of the skin
- Pain
- Tingling
- Physical weakness
- Numbness
- Paralysis
- Breathing difficulties
- Vision, hearing or speech disturbance
- Vertigo
- Nausea
- Impaired consciousness
Venous DCS bubbles & arterialised DCS bubbles & AGE bubbles may be treated similarly.

Inert gas bubbles → DCS → Shunt mechanisms → AGE → Pulmonary barotrauma

Shunt mechanisms

DCI

Mediastinal emphysema
Pneumothorax

From: Guideline ‘Diving Accident’ www.gtuem.org

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DSC + AGE = DCI
Decompression Injury

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Thank you for your attention