

DECOMPRESSION & BAROTRAUMA

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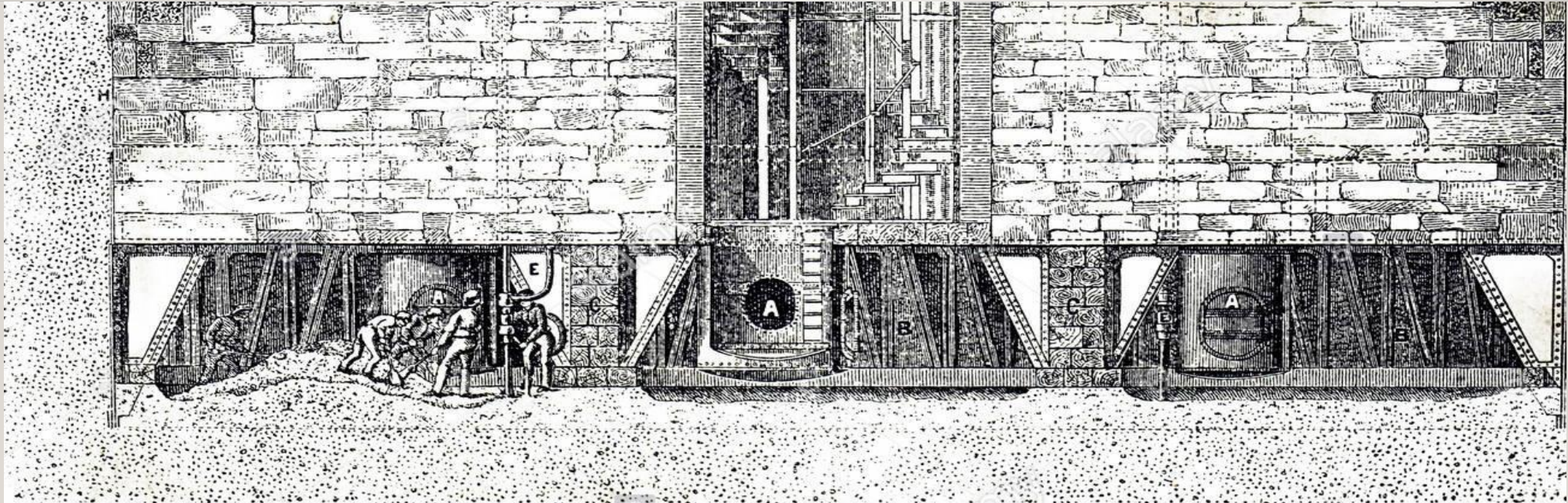
Courtesy of Dr. Rudy Britz



DECOMPRESSION DISEASE

- Also called “bends”, dysbarism but first known as Caissons disease in 1850. There is a distinct difference between compressed air and altitude decompression disease.
- I.e. The supersaturation of tissues with nitrogen.
- Normally nitrogen is removed by breathing.
- The partial pressure of the Nitrogen in the body equals that of the partial pressure of the nitrogen in the outside air
- This is about 1 Liter
- When outside air pressure drops during ascent tissues become supersaturated with nitrogen and we have formation of bubbles.

CAISSON'S DISEASE



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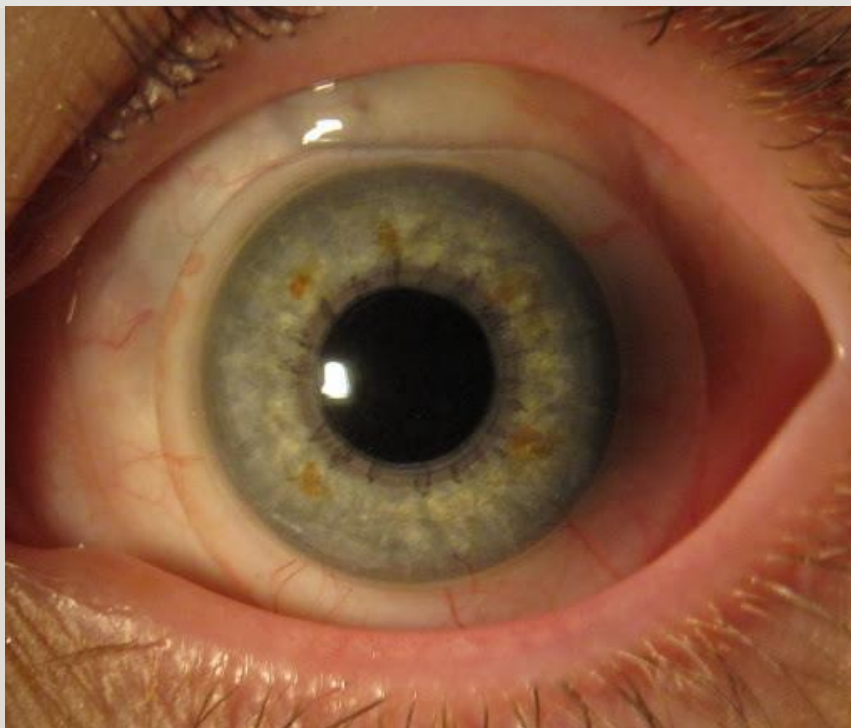
BUBBLE FORMATION

- The driving force for this bubble formation in a fluid is the pressure difference between the partial pressure of the gas dissolved in the fluid and the absolute pressure.
- Bubble formation is greater in different tissues and lipid tissue is the highest.
- Bubbles only form in a fluid when certain suitable nuclei are available e.g. microscopic gases or small particles
- Decompression occurs in exposure to a reduced atmosphere in a decompression chamber or in flight
- Most of us are divers and wary of this disease, but it can happen if exposed to altitude 28000 ft for longer than 2 hours.
- It may occur much lower at 18000ft when exposed to hyperbaric environment such as diving
- 12 Hours between diving and flying

BUBBLE TROUBLE



BUBBLE FORMATION IN EYE



CLINICAL MANIFESTATIONS OF DECOMPRESSION SICKNESS

- Joint and limbs “bends”
- Ill localized and deep seated (may recover or collapse)
- Bubbles may be seen on x ray (usually knee ,shoulder, foot, wrist or hands).
- Skin mottling, rashes and urticaria.
- Respiratory symptoms (chokes)A deep breath gives the” inspiratory snatch” i.e. a painful inspiration and soreness under sternum.Very serious symptoms
- Pulmonary arterioles and capillaries are irritated due to gas bubbles
- Neurological manifestations such as fits paralysis and paresthesia and collapse
- Visual ,blurred vision, scotomata and hemianopia.

MARBLING



INCIDENCE OF DECOMPRESSION

- General factors
- Altitude 18000 ft is minimum
- Base altitude. No flying after being exposed to 2 atmosphere (34 meters) for at least 12 hours.
- Rate of ascent and exposure time, normally 20 -60 minutes
- Re exposure and exercise
- Hypoxia and low temperatures
- Repeated exposure

PERSONAL FACTORS

- Age 17-20 and 27-29 ninefold increase also greater in obese individuals
- Injury
- Infection and post alcohol.
- True individual susceptibility, History of a previous decompression illness increases the risk of follow up incident.
- Myocardial ischemia ,spontaneous pneumothorax, septicemia
- Flight stresses like pressure vertigo, abdominal distension, hypoxia, motion sickness
- Psychological stresses anxiety claustrophobia and hyperventilation.

MEDICAL TREATMENT

- 100% oxygen inhalation.
- If unconscious assist ventilation, assist cardiac function.
- IV Dextran 40% in 30 min.
- Valium 5mg, Aspirin 300mg, 2 tabs, Vitamin C 250mg ,2 tabs, Medrol 16 mg 2 tabs.
- IV Decadron 8mg every 6 hours IV.
- Administer 50 ml of 50% dextrose in first drip.
- Catheterize and check 60ml/hr. monitor Bp and pulse.
- Clexane 40mg every 6 hours.

MS. PIGGY



TREATMENT OF DECOMPRESSION DISEASE

- Descend.
- Recompression to ground level
- 100% oxygen
- Treatment of choice is re-compression in oxygen chamber
- Transport (Medivac) at 1000ft if possible, to chamber

HYPERBARIC CHAMBER INSIDE



COMPRESSION THERAPY (HYPERBARIC CHAMBER)

- Compress rapidly to 2.8 atmosphere breathing 100% oxygen if marked improvement continue for 30 - 60 min.
- If not compress to 6 atmospheres.
- A single striking feature of altitude sickness is rapid and complete recovery but remain cautious for osteonecrosis of femur and humerus neck.

BEST TREATMENT FOR ALTITUDE DECOMPRESSION DISEASE IS BACK ON THE GROUND



MONOPLACE CHAMBER



PREVENTION OF DECOMPRESSION DISEASE.

- Reduce environmental pressure and duration of exposure to low pressure or eliminate nitrogen using 100% oxygen before exposure.
- High risk with military pilots and cabins exposed to more than 22000 ft.
- Pre oxygenation for more than 30 minutes. Will help up to 48000ft for 10 minutes.
- Pre oxygenation for 3 hours will give endurance of 3 hours at 40000ft.

SLOW DECOMPRESSION AND RAPID DECOMPRESSION.

- Rapid decompression i.e..The window blows out and cabin pressure is lost. Rapid descent to 10,000ft and overhead oxygen masks become available.
- Slow decompression kills. Compressor leak or some malfunction at example 24000 ft leads to hypoxia and death.Always when doing medivacs use a divers watch.

RAPID DECOMPRESSION



DECOMPRESSION IN AIRCRAFT



BAROTRAUMA

- Definition: tissue damage resulting from the expansion and contraction of enclosed gas spaces, it is a direct effect of the gas volume changes causing tissue damage.
- Boyles law: At a given temp the volume of a gas will vary inversely with absolute pressure.
- One liter of gas at 33 feet (10 meters) underwater will be reduced to 0,5 liter (2 ATA)
- One liter of gas at 90 meters will only reduce a further 1/10th of a liter.
- Biggest differential is at 10 meters
- Always remember at 18000 ft we have only 50% of our atmospheric pressure and double the volume
- Time of useful consciousness is 30 min

BAROTRAUMA OF DESCENT

- Barotrauma during compression in a chamber or during diving (increased pressures of the surrounding area)
- Pressure imbalance due to the inability to equalize pressure in the bodily cavity as depth increases and gives rise to damage of mucous membranes oedema and hemorrhage.

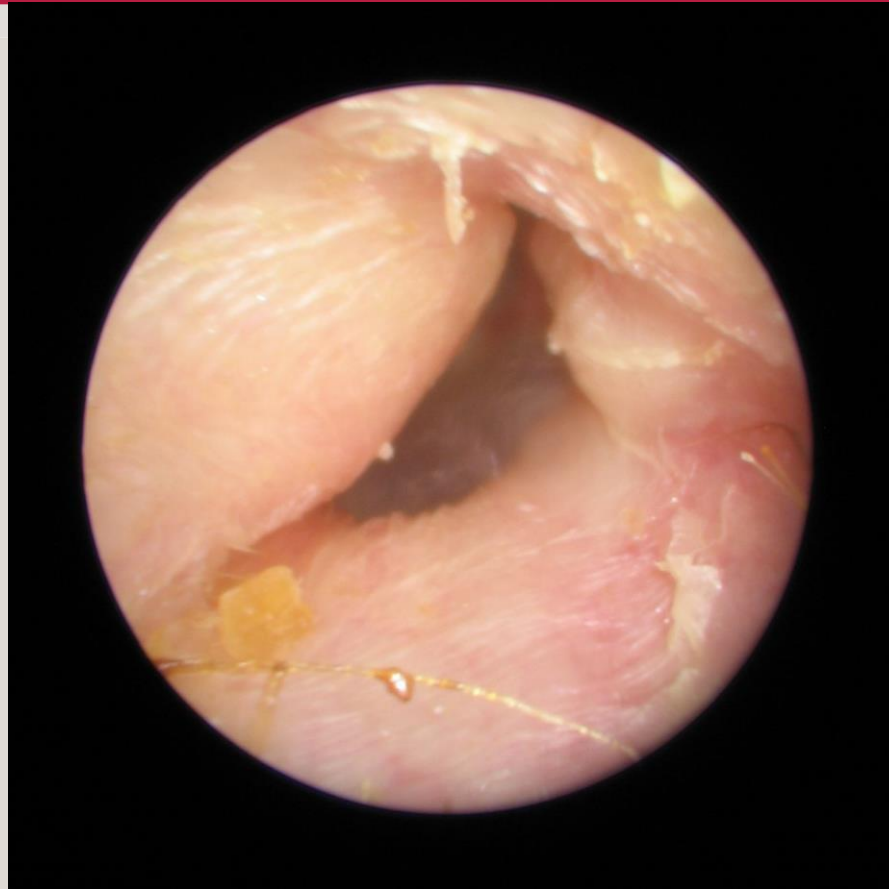
BAROTRAUMA OF ASCENT

- This is the result of distension of tissues by enclosed expanding gases.
- This occurs when environmental pressures are reduced, i.e., decompression in a chamber and ascent in air or water.
- Most common disorder in flying is the barotrauma of the ear.
- This is divided into external middle and inner ear.

EXTERNAL EAR BAROTRAUMA

- When external ear is blocked with cerumen, exostosis or tight-fitting ear plugs.
- Contraction of the trapped air leads to congestion and hemorrhage of the tympanic membrane.
- Clinically Valsalva is difficult to perform, and pain may be present
- Treatment: remove hoods, plugs and exostosis
- Vertigo case at Wonderboom Airport was ear squeeze due to headset

EXOSTOSIS (SURFERS' EAR)



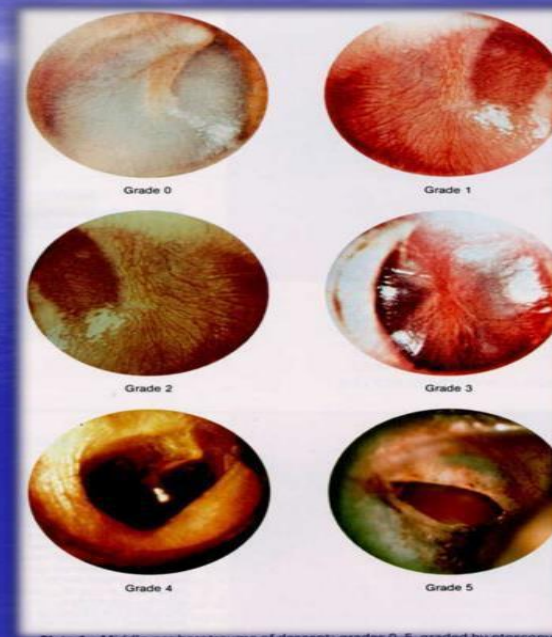
BAROTRAUMA OF THE MIDDLE EAR

- The most common disorder in flying and diving is the failure of the middle ear to equalize the pressure difference via the Eustachian tube
- Any condition which tends to block the eustachian tube predisposes to middle ear barotrauma.
- Symptoms are intense pain, feeling of fullness and even alternobaric vertigo.
- The pressure can be relieved by yawning, swallowing, chewing gum or inflating ear cavity with Valsalva maneuver.
- Medication not allowed in flying, but in diving we use Stugeron and valoid.
- The most effective test for Eustachian tube potency is the hypobaric chamber test, ascending to 18000ft

MIDDLE EAR BAROTRAUMA

Middle Ear Barotrauma

- Various grades of injury of TM
 - 1 – Capillary dilation
 - 2 – Mucosal edema
 - 3 – Hemorrhage into TM
 - 4 – Hemorrhage or serous exudate
 - 5 – TM rupture
- Treat conservatively



INNER EAR BAROTRAUMA

- Mechanism: The inward movement of the tympanic membrane because of the pressure gradient pushes the footplate of the stapes inwards, the round window bulges and ruptures.
- Tinnitus, vertigo, ataxia and hearing loss may occur (either total or 4000-6000Hz).
- Audiometry of up to 8000Hz and electronystagmography is needed.
- Medical emergency It must be repaired or loss will be permanent.
- Permanently unfit for diving and fit for flying after recovery (restriction of aerobatic maneuvers)

PARANASAL SINUSES

- Symptoms and signs:
- Sensation of tightness and pressure over sinuses.
- Blood and mucous in the nose or pharynx.
- Pain usually over frontal sinus and may be referred to upper teeth.
- Treatment:
- X-ray examination, decongestants double therapy antibiotics and steroids.

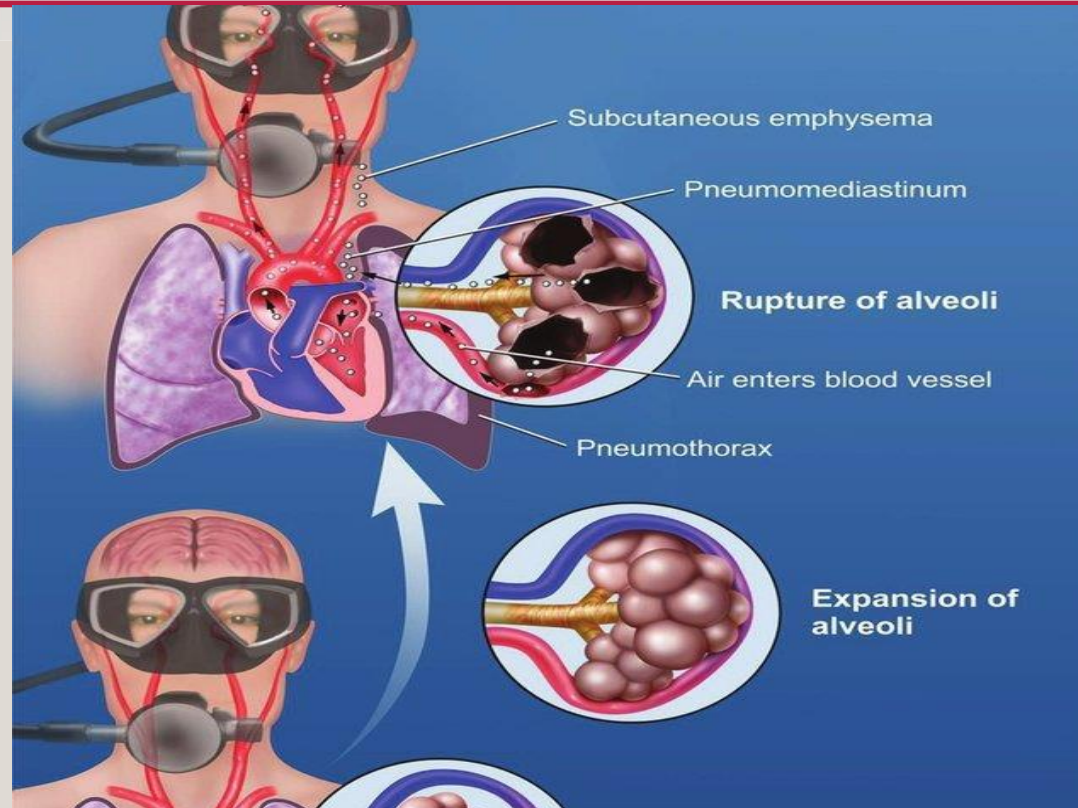
BAROTRAUMA OF THE LUNGS

- Predisposing pathology:
- Asthma, cysts, tumors, fibrosis and bullae.
- Symptoms are dyspnea, cough and hemoptysis.
- A diver with a lung volume of 6 liters at 10 meters must exhale 6 liters of gas at during ascent in order to maintain normal 6 liter volume at the surface. This is relative easy to maintain
- However if breath holding takes place the risk increase dramatically
- During rapid decompression in flight, the rate of decompression of the cabin in relation to simultaneous rate of decompression of the lung plays the most important role.

PULMONARY BAROTRAUMA

- Pulmonary tissue damage
- Surgical emphysema
- Pneumothorax
- Air embolism
- Clinical signs are:
- Hoarseness, feeling of fullness in the throat, pleuritic pain, dyspnea, dysphagia, syncope and shock
- Always insert chest drain and transport at 1000ft

PULMONARY BAROTRAUMA



AIR EMBOLISM

- Gas passing into pulmonary veins and into systemic circulation causing vascular obstruction and infarction.
- Clinical signs: confusion aphasia, loc, paresis, gas bubbles in retina abnormal ECG and EEG.
- Treatment is urgent: immediate recompression.

CONDITIONS THAT SHOULD NEVER FLY

- Large unreduced hernias
- Bowel obstruction
- Pneumothorax
- Recent air contrast studies of the brain
- Acute appendicitis, cholecystitis, and diverticulitis.
- Acute peptic ulceration.
- Recent bowel surgery

FUTURE OF FLYING



THANK YOU

- Enjoy the world of aviation
- Special thank you to google for pictures and illustrations.