RESPIRATORY BLOCK

Physiology Team~ 430

10th Lecture

Effects of low and high gas pressure on the body

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- **Effect of increased barometric pressure(deep sea diving):**
  - **When human descend below the sea, the pressure around them increased (the more deep the diver gets under water, the higher pressure on his lungs).**
  - **To prevent the lungs from collapse , air must be supplied also under high pressure (the formula is N2 + O2) which puts the body in certain limits under forced physiologic changes)**

For each 33 ft. (10 meters) under water, one more atmosphere act against the body

More gasses will be absorbed by the body
(تزداد كمية الغازات الممتصة في الجسم مع زيادة الضغط تحت الماء)

- **Nitrogen Narcosis at High Nitrogen Pressure:**

A condition of confusion or stupor(سبات او غيبوبة) resulting from increased levels of dissolved nitrogen in the blood, as that occurring in deep-sea divers breathing air under high pressure.

- **Mechanism of nitrogen narcosis :**

1- Nitrogen dissolves freely in fatty substances, especially the membranes of the neurons

2- alter ionic concentration .

3- ↓ neuronal excitability → no impulses → narcosis

More pressure under water → more nitrogen solubility with tissues.

The nitrogen Has characteristics similar to those of alcohol Intoxication and the problem with it that can be absorbed and released by the body very slowly

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- **Decompression Sickness**

- Definition:

If a diver has been beneath the sea long enough that large amounts of nitrogen have been dissolved in his or her body and the diver suddenly comes back to surface of the sea, significant quantities of nitrogen bubbles can develop in the body fluids and enter the blood, blocking blood vessels and causing ischemia and sometimes tissue death

- **During slow ascent , nitrogen is slowly removed from the tissues since the partial pressure there is higher than that in the arterial blood and alveolar gas**

- **If decompression is rapid , bubbles of gaseous nitrogen are released, in tissues and blood ,causing the symptoms of decompression sickness(the bends or caisson disease)**

- Symptoms and signs :

1-fatigue or drowsiness after decompression

2-skin itch

3-bubbles in the tissues cause sever pains particularly around the joints.

4-Neurological symptoms include paresthesia ,itching ,paralysis , and inner ear disturbances.

5-thoracic pains.

6-Bubbles in the coronary arteries may cause myocardial damage.

7-Decompression sickness shock, capillaries become permeable to plasma and hypovolemiarapidly develop.

8-Edema may be prominent and shock is also usually complicated by pulmonary edema.

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- Prevention and treatment:

A) Rising slowly to the surface:

a large amount of nitrogen will diffuse through the alveoli and be eliminated in the expired breath, preventing decompression sickness.

B) Helium-oxygen mixture

instead of a nitrogen-oxygen mixture in the diver's breathing tank

- **benefits of helium oxygen mixture :**

  -- helium is only 1/5 as narcotic as nitrogen, and slowly,

  -- 1/7 the molecular weight of nitrogen.

  -- it is less dense than N2, and it keeps the airway resistance for breathing at a minimum.

  -- High difusibility through tissues which allows rapid removal of He than N2 from body fluids.

  -- Helium is about 1/2 as soluble as nitrogen in body fluids. This reduces the quantity of bubbles that can form in tissues when the diver is decompressed after.

- **Disadvantages of oxygen-helium mixture at high pressure:**

  -- It could cause oxygen toxicity due to breathing high oxygen tension.

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- **Effects of low oxygen pressure on the body (Aviation-ascend to high altitude):**

  - **At the sea level the barometric pressure is 760 mmHg.**
  - **At 10,000 feet is 523 mmHg**
  - **At 50,000 feet 87 mmHg.**

This decrease in barometric pressure is the basic cause of all the hypoxia problems in high altitude in physiology. (Because when the barometric pressure decreases, the PO2 decreases proportionately. And that causes the blood to carry less O2 to the tissue (low Hb saturation) which leads to hypoxia.)

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- **Alveolar PO2 at different altitudes:**

  - **As the barometric pressure decreases, the oxygen partial pressure decreases proportionally, remaining less than 21 % of the total barometric pressure.**
  - **At sea level PO2= 159 mmHg.**
  - **At 20,000 feet PO2= 40 mmHg.**
  - **At 50,000 feet only 18 mmHg.**

Even at high altitude CO2 is continuously excreted from the pulmonary blood into the alveoli. Also, water vaporizes into the inspired air from the respiratory surfaces. Therefore, these two gases dilute the oxygen in the alveoli, thus reducing the oxygen concentration.

(هذا يوضح ان قطرات الماء وثاني اكسيد الكربون تقلل من تركيز الاكسجين)

- **Saturation of Hb with O2 at different altitudes:**
  - **Up to an altitude of approximately 10,000 feet, even when air is breathed, the arterial oxygen saturation remains at least as high as 90%.**
  - **Above 10,000 feet the arterial oxygen saturation falls progressively, until it is only 70% at 20,000 feet and still very much less at higher altitudes.**

(كلما ارتفعنا عن سطح الأرض يقل الضغط الجوي وبالتالي يقل تركيز الأكسجين الموجود بالهواء)

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- **Acclimatization (التأقلم) to low PO2:**

person remaining at high altitudes for days , weeks or years becomes more and more acclimatized to low PO2, so that it causes fewer deleterious (مضر) effects on the body and it becomes possible for the person to work harder without hypoxic effects or to ascend to still higher altitude

- **Principle means of acclimatization:**

1-increase in pulmonary ventilation.

2-increased red blood cells(polycythemia).

3-increased diffusing capacity of the respiratory membrane.

4-increased vascularity of the tissues. (زيادة عدد الأوعية الدموية)

5-Increased ability of the cells to utilize oxygen through ↑ Levels of oxidative enzymes & mitochondria

Good Luck