



## Effects of low and high gas pressure on the body

## OBJECTIVES

- 1-Describe the effects of exposure to low and high barometric pressures on the body.
- 2- Describe the body acclimatization to low barometric pressure.
- 3-Define decompression sickness and explain how it can be avoided.
- 4-Understand the effects of high nitrogen pressure, and nitrogen narcosis.

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## COLOR INDEX:

- Red = important
- Grey = additional notes

# 1-effect of increased barometric<sup>1</sup> pressure (deep sea diving) :

When human descend<sup>1</sup> below the sea, the pressure around them increase as well as the lung tendency to collapse .

To prevent the lungs from collapsing , air must be supplied also under high pressure which exposis the blood in the lungs to extremely high alveolar gas pressure ( hyperbarism )

- ✓ Under certain limits these high pressures cause tremendous alterations in the physiology of the body .
- ✓ The surrounding pressure increases by 1 atmosphere for every 10 meter (33feet) of depth in sea water
- ✓ Therefore at a depth of 31 meter (100feet ) in the ocean the diver is exposed to a pressure of 4 atmospheres

## These problems confront<sup>2</sup> SCUBA (self contained under water breathing apparatus)

### \*\* DEEP-SEA DIVING (HIGH PRESSURE):

- Relationship of Pressure to Sea Depth : a person 33 feet beneath the ocean surface is exposed to 2 atmospheres pressure .
- At 66 feet the pressure is 3 atmospheres, and so forth..

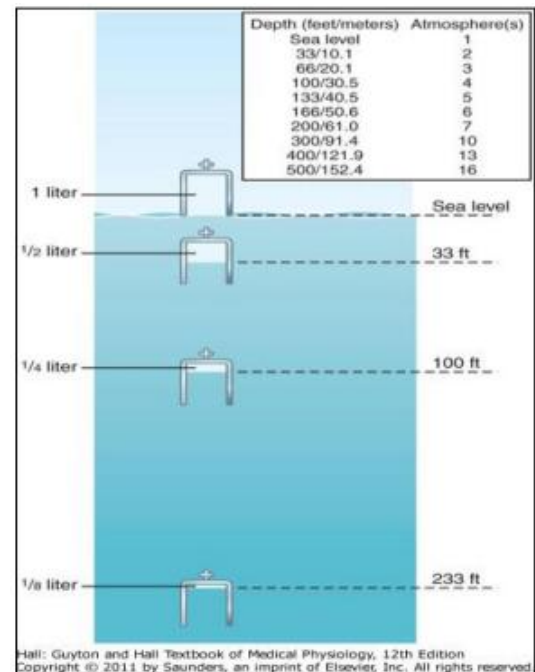
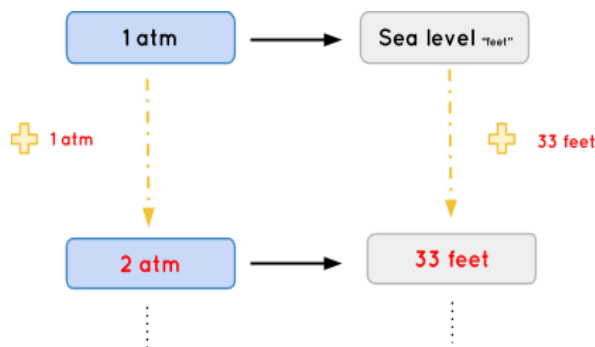
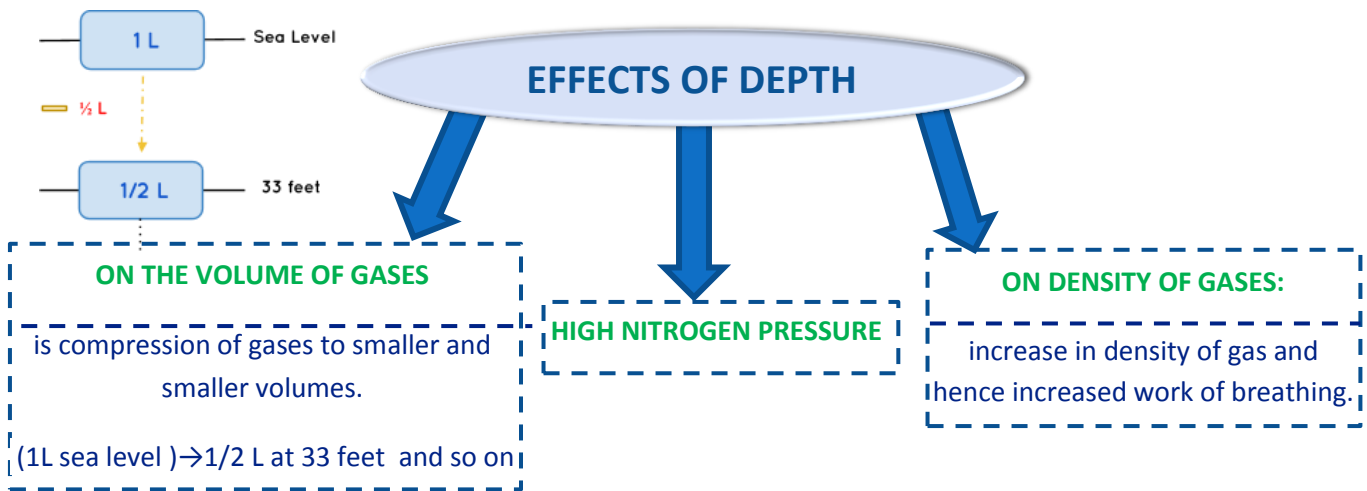


Figure 44-1 Effect of sea depth on pressure (top table) and on gas volume (bottom).

1 An instrument used to measure atmospheric pressure.

2 meet face to face (مواجهه)



## 2- NITROGEN EFFECT AT HIGH NITROGEN PRESSURE:

has 2 principles effects: A. Nitrogen narcosis (anesthetic<sup>3</sup> effect) B. Decompression sickness

### A. NITROGEN NARCOSIS<sup>4</sup> AT HIGH NITROGEN PRESSURES :



**HOW?** ✓ About four fifths  $\frac{4}{5}$  of the air is nitrogen . At sea-level pressure, the nitrogen has no significant effect on bodily function but at high pressures it can cause varying degrees of narcosis.

Nitrogen like most other anesthetic gases, dissolve freely in the fats of the body including the membranes and other lipid structures of the neurons. This lead to alteration of the electrical conductance of the membranes , reduces their excitability and subsequent necrosis develops.

( nitrogen narcosis has characteristics similar to those of alcohol intoxication )

- At 120 feet ; the diver lose many of his cares.
- At 150 feet ; there is a feeling of euphoria(happiness) + drowsiness and impaired performance .
- At higher pressure ; loss of coordination and finally coma might develop.

### B. DECOMPRESSION SICKNESS<sup>5</sup> (Cassion's disease) :

During decent, the high partial pressure of nitrogen that the diver breathing from diving air compressor forces the nitrogen to be absorbed in fat(having high  $N_2$  solubility).



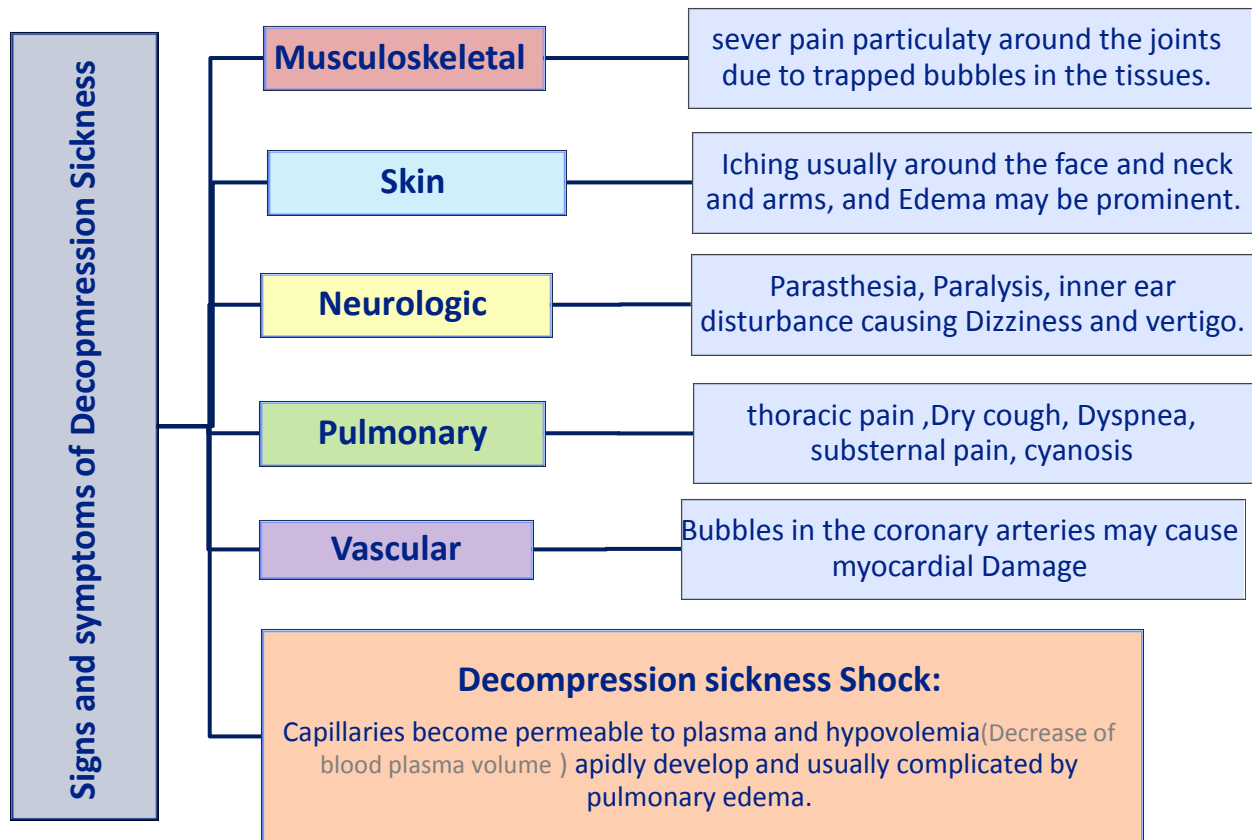
On ascending, due to higher partial pressure of  $N_2$  in the fat than in the blood , the faster the ascent the less time there is for absorbed gas to be offloaded safely through the lungs, causing these gases to come out of solution and form "micro bubbles" in the blood.

<sup>4</sup> be careful it is not necrosis.. this means Anesthetization

<sup>5</sup> a syndrome caused by a decrease in the ambient pressure which occur in animal and men when the tissues of the body contain an excess of physically inert gas.

## \*\* SIGNS AND SYMPTOMS OF DECOMPRESSION SICKNESS:

- The **mildest form** of DS is fatigue or drowsiness and locally there is skin itch
- Other **sever** symptoms may occur :



## \*\*TREATMENT OF DECOMPRESSION SYMPTOMS:

Rapid Recompression in a pressure chamber is applied, followed by slower Decompression to reduce the volume of Nitrogen bubbles and force them back to solution.

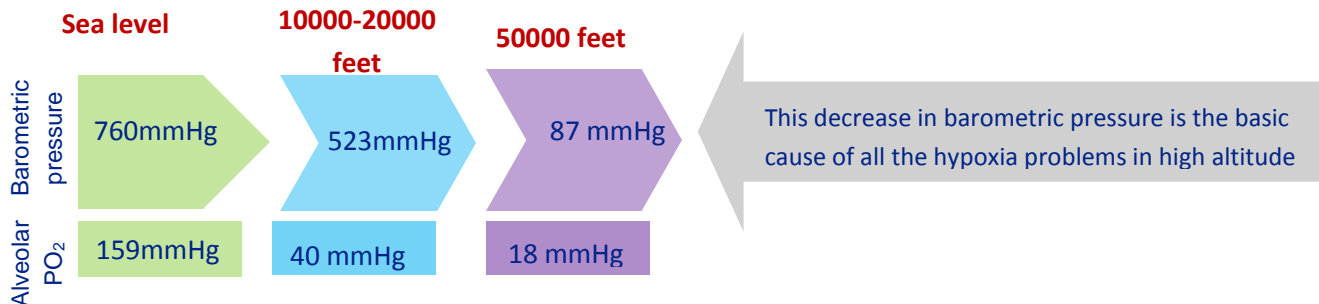
## \*\*PREVENTION OF DECOMPRESSION SICKNESS:

Helium-O<sub>2</sub> mixture is more desirable than Nitrogen-O<sub>2</sub> Mixture in deep dives , because it has :

- 1\4 – 1\5 the narcotic effect of Nitrogen on CNS.
- 1\7 the molecular weight of nitrogen.
- Less airway resistance due to it's low density.
- High diffusion through tissues.
- 1\2 solubility of Nitrogen in body fluid, so that's reduces the quantity of bubbles formed in tissues.

### 3.EFFECTS OF LOW OXYGEN PRESSURE ON THE BODY :

The Barometric pressure decreases as we ascend to High altitude. As the barometric pressure decreases, the oxygen partial pressure decreases proportionally, remaining less than 21% of the total.



Even at high altitude, CO<sub>2</sub> is continuously excreted from the pulmonary blood to the alveoli + water vaporizes into the inspired air from the respiratory surfaces (participate in low PO<sub>2</sub>)

Therefore, these two gases dilute oxygen and reduce its concentration in the alveoli which lead to Hypoxia.

#### EFFECTS OF ACUTE HYPOXIA: (SYMPTOMS DEPENDS ON HIGHT)

- ✓ at 12,000 feet, acute effects E.g.: Drowsiness, lassitude (state of physical or mental weariness; lack of energy), mental and muscle fatigue, headache, occasionally nausea and sometimes euphoria.
- ✓ At 18,000 feet, stage of twitching and convulsions.
- ✓ At 23,000 feet and above, the unacclimatized person can enter into coma.

### 4-ACCLIMATIZATION TO LOW PO<sub>2</sub> :

A person who remains at high altitudes for days, weeks or years becomes acclimatized to low PO<sub>2</sub>, and can work harder without hypoxic effects or ascend to still higher altitude .

#### \*\*PRINCIPAL MEANS OF ACCLIMATIZATION<sup>6</sup>:

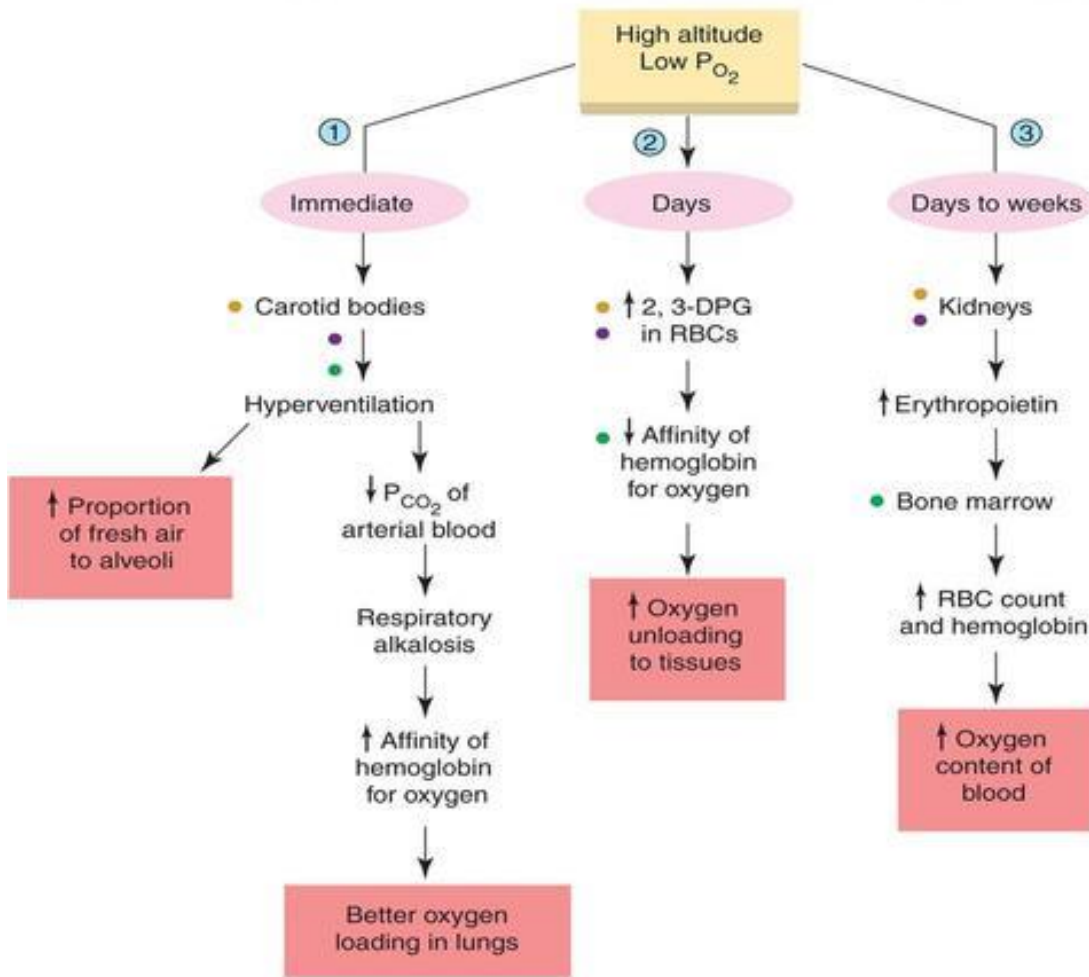
- 1- Increase in pulmonary ventilation.
- 2- Kidneys secretes erythropoietin<sup>7</sup> ( more RBCs and hence Hb carriers )
- 3- Increased diffusion capacity of the lungs.
- 4- Increased vascularity of the tissues.
- 5- Increased ability of the cells to utilize oxygen despite the low PO<sub>2</sub>.

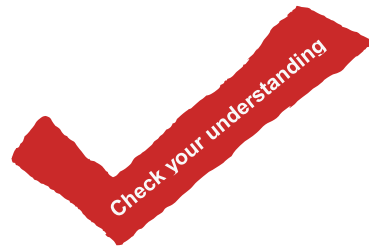
<sup>6</sup> How is your body going to react against hypoxia

<sup>7</sup> very important enzyme for erythropoiesis ( the process which produces red blood cells) , Erythropoietin stimulates bone marrow to produce more blood cells.

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