



# Hypoxia & Cyanosis

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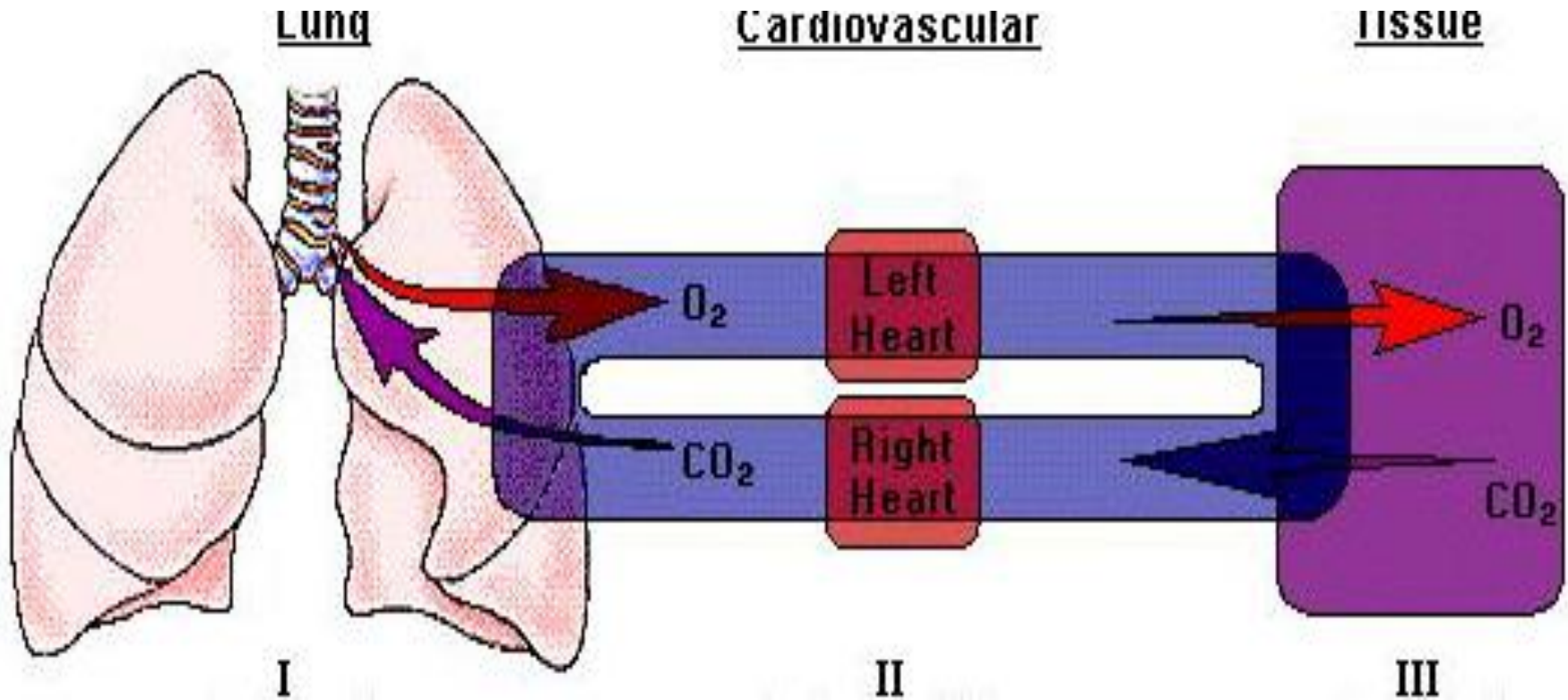
**Prof. Khaled Abdel-Sater, MD**

# HYPOXIA

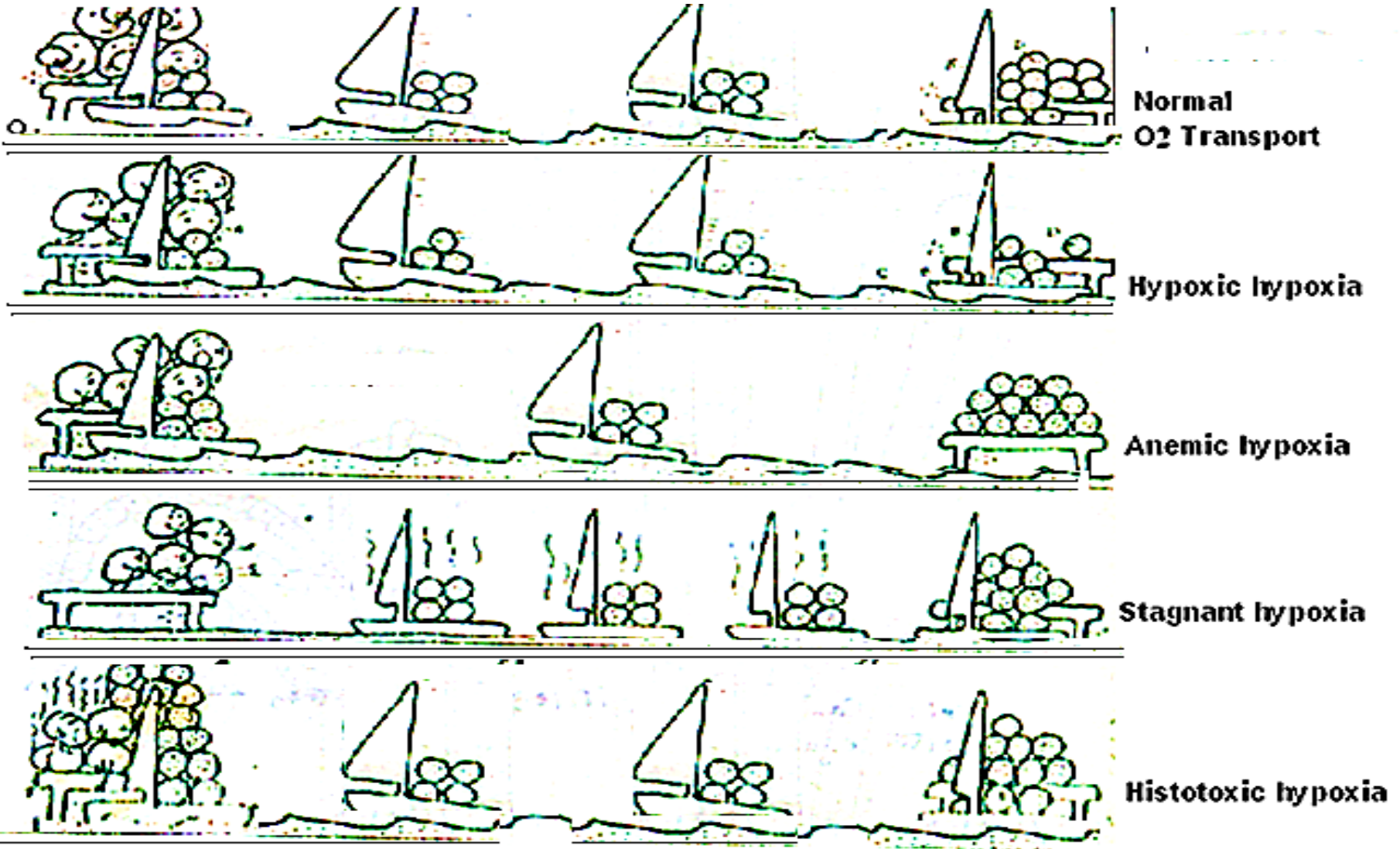
## ● Definition:

It is the decreased of  $O_2$  supply or  $O_2$  utilization at the tissue.

## ● Normal $O_2$ Transport:



# ● Types of Hypoxia





# Types of Hypoxia



Hypoxic

Anemic

Stagnant

Histotoxic

# 1-Hypoxic Hypoxia: *The most common type of hypoxia*

## ● Definition:

It is the decreased of O<sub>2</sub> supply to the tissue secondary to decrease of arterial O<sub>2</sub> tension.

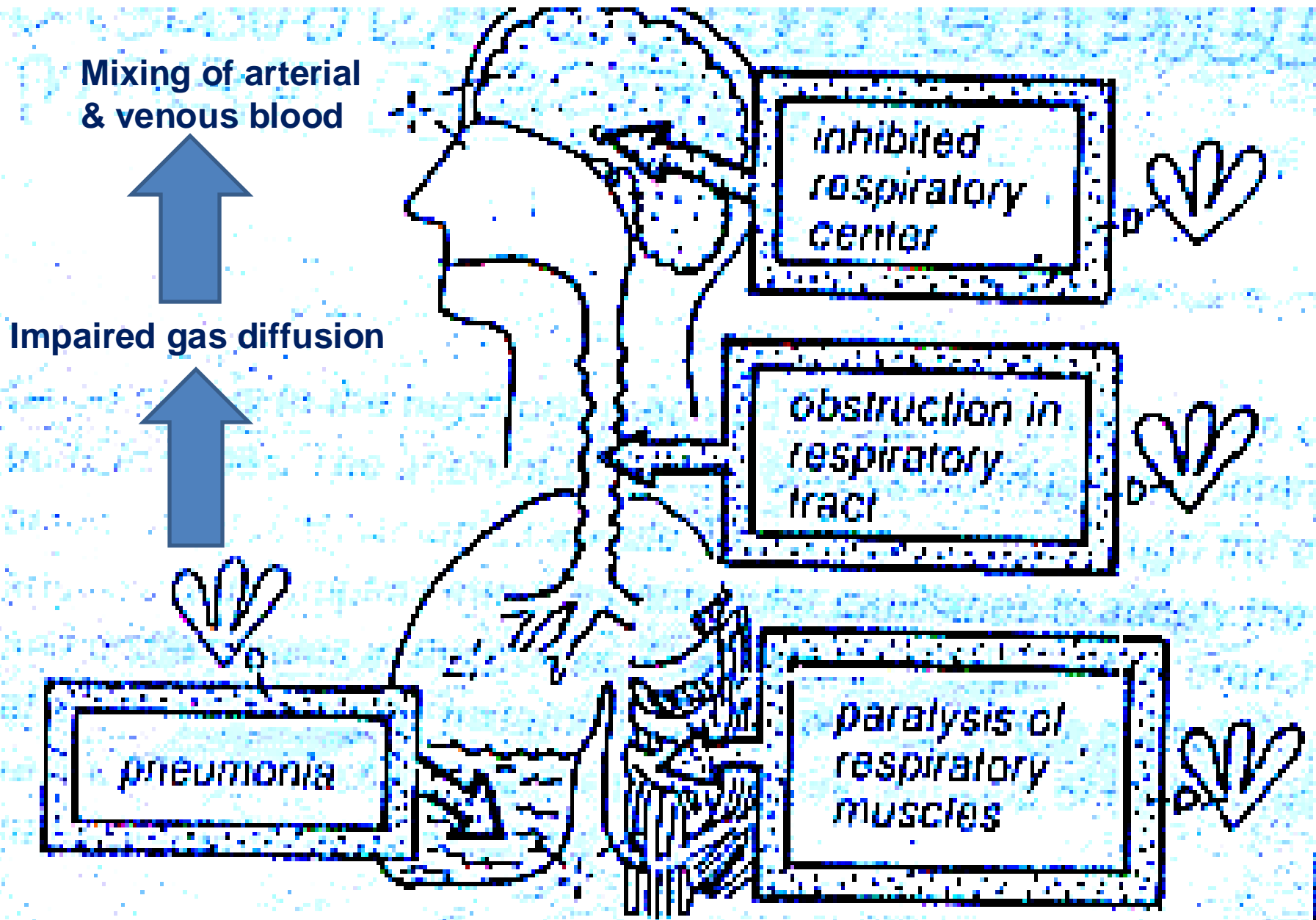
## ● Causes:

a- **Decrease** O<sub>2</sub> in atmosphere as in high altitude.

b- **Decrease** gas exchange in lung as in:

- Inhibition of respiratory centers (e.g. by morphine).
- Obstructive diseases (e.g. bronchial asthma).
- Restrictive diseases (e.g. Paralysis of respiratory muscles).
- Presence of lung diseases e.g. pneumonia.
- Impaired gas diffusion e.g. ↓respiratory membrane surface area.

c- **Mixing** of arterial and venous blood.



Mixing of arterial  
& venous blood

Impaired gas diffusion

*inhibited  
respiratory  
center*

*obstruction in  
respiratory  
tract*

*paralysis of  
respiratory  
muscles*

*pneumonia*



# 2-Anemic Hypoxia:

● **Definition:** It is the decreased of O<sub>2</sub> supply to the tissue secondary to decrease of content or function of hemoglobin.

● **Causes:**

نقص الهيموجلوبين كما او كيفا

**a- Decrease** of hemoglobin content in red blood cell as in all types of anemia.

**b- Decrease** of the function of hemoglobin as in:

- Met-hemoglobin (i.e. Fe<sup>++</sup> in hemoglobin become Fe<sup>+++</sup> due to excess oxidizing agent).
- Sulf-hemoglobin (i.e. combined of H<sub>2</sub>S to hemoglobin at the same site of O<sub>2</sub>).
- Carboxy-hemoglobin (i.e. combined of CO to hemoglobin at the same site of O<sub>2</sub>).

# 3-Stagnant Hypoxia

## ● Definition:

It is the decreased of O<sub>2</sub> supply to the tissue secondary to decrease of blood flow to the tissues.

## ● Causes:

- 1- Generalized hypoxia due to generalized stagnation of the blood e.g. congestive heart failure.
- 2- Localized hypoxia due to localized stagnation of the blood e.g. localized thrombosis or vasoconstriction.



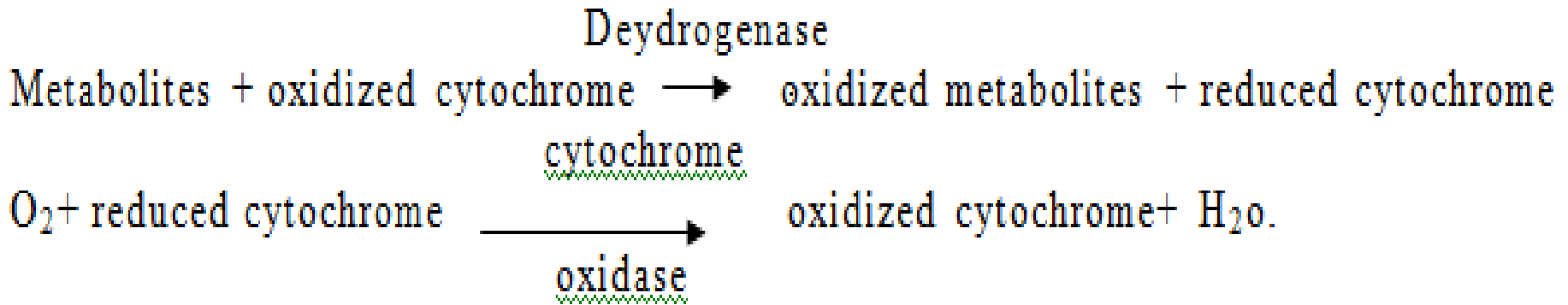
# 4-Histotoxic Hypoxia:

histo = انسجه Toxic تسمم

- **Definition:** It is the decreased of O<sub>2</sub> supply to the tissue secondary to inability of the tissues to O<sub>2</sub> utilization.

كالبعير في الصحراء يقتلها الظمأ  
والماء على الوري محمول

- **Normal O<sub>2</sub> Utilization by the Tissue:**




- **Causes:**

دا أسرع سم بيموت في العالم

- 1- Cyanide poisoning due to inhibition of cytochrome oxidase.
- 2- Alcohol (or barbiturate) poisoning due to inhibition of deydrogenase enzyme.

مارلين مونرو

 **Hypoxia**

 **Hypoxic Hypoxia**

 **Decrease of O2 in atmosphere**

 **Gas exchange issues in lungs**

 **Right to left cardiac shunts**

 **Anemic Hypoxia**

 **Decrease of hemoglobin content**

 **Decrease of hemoglobin function**

 **Stagnant Hypoxia**

 **Generalized stagnation**

 **Localized stagnation**

 **Histotoxic Hypoxia**

 **Cyanide poisoning**

 **Alcohol poisoning**

# ● Characters of Hypoxia

Types of hypoxia	O <sub>2</sub> supply to tissue	Arterial O <sub>2</sub> tension	O <sub>2</sub> carrying capacity	Rate of blood flow	Utilization by tissue	Venous O <sub>2</sub> content
<b>Hypoxic hypoxia</b>	↓ ↓	↓ ↓	Normal	Normal	Normal	↓ ↓
<b>Anemic hypoxia.</b>	↓ ↓	Normal	↓ ↓	Normal	Normal	↓ ↓
<b>Stagnant hypoxia</b>	↓ ↓	Normal	Normal	↓ ↓	Normal	↓ ↓
<b>Histotoxic hypoxia</b>	↓ ↓	Normal	Normal	Normal	↓ ↓	Supper normal

# SYMPTOMS OF HYPOXIA

Early

R - Restlessness

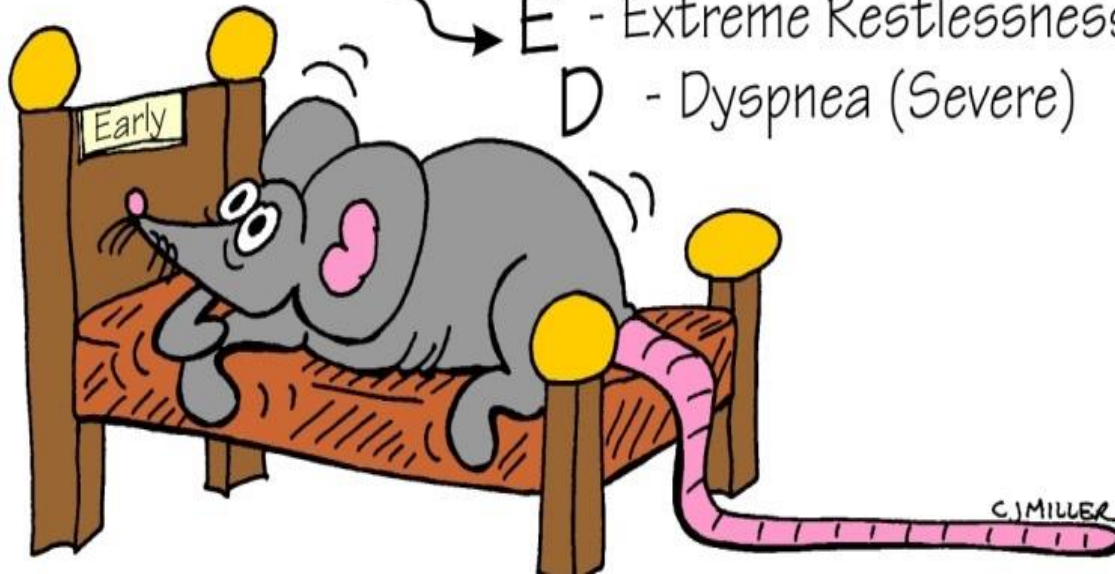
A - Anxiety

T - Tachycardia/Tachypnea

is Late to B - Bradycardia

E - Extreme Restlessness

D - Dyspnea (Severe)



C. MILLER



## Acclimatization to high altitude

1- Hyperventilation (due to of respiratory centers by peripheral chemoreceptors) → ↑  $\text{Co}_2$  wash → alkalosis (corrected by kidneys).

2- ↑ RBCs by release of erythropoietin hormone from kidneys.

3- Increased of blood flow, cardiac output, heart rate and arterial blood pressure.

4- Increased of  $\text{O}_2$  liberation to tissues due to increased of 2,3 DPG.

5- Increased of  $\text{O}_2$  utilization by the tissue due to increased of cytochrome oxidase enzyme.



Dr Khaled Abdel-Sater

## N.B. Role of kidneys in acclimatization to high altitude:

a- Secretion of erythropoietin hormone (→ ↑↑ RBCs).

b- Excretion of bicarbonate (which correct alkalosis).

So the pH of urine in high altitude becomes alkaline.





It is the bluish discoloration of the skin and mucous membrane due to increased amount of reduced hemoglobin above 5 gm % in capillary blood. (normally = 2.7 gm%)

**Def.,**

**Causes**

- a- All causes of hypoxic hypoxia ( $\downarrow$  Hb saturation  $\rightarrow$   $\uparrow$  reduced Hb).
- b- All causes of stagnant hypoxia (more time for extraction of O<sub>2</sub>).
- c- All causes of asphyxia.
- d- In sever muscular exercise.
- e- In exposure to moderate cold

**Types**

- a-Central cyanosis e.g. obstructive lung disease. It present allover the body.
- b- Peripheral cyanosis as in decrease of blood flow & O<sub>2</sub> delivery to tissues.

## Cyanosis

ازرق = Cyan

**Factors Modified**

- 1- **Skin thickness:** thick skin decreases cyanosis.
- 2- **Skin pigmentation** masks the cyanosis e.g. jaundice.
- 3- **Skin vasoconstriction** increases cyanosis.
- 4- The amounts of Hb: in polycythemia because of reduced rate of blood flow due to increased viscosity.

**N.B.**

- Types of Hypoxia Can not Caused Cyanosis:**
- a- Anemic hypoxia because the total amount of hemoglobin is decreased and so reduced hemoglobin is also decreased.
  - b- Histotoxic hypoxia because all hemoglobin in the venous is saturated (no reduced Hb).

