



Hypoxia and cyanosis

OBJECTIVES

- Define hypoxia and list its various physiological and pathological causes
- Define hypo and hyper-ventilation in terms of arterial PCO₂ and PO₂.
- Define cyanosis and its clinical presentation
- Define ventilation/perfusion (V_E/Q) ratio and its normal values..

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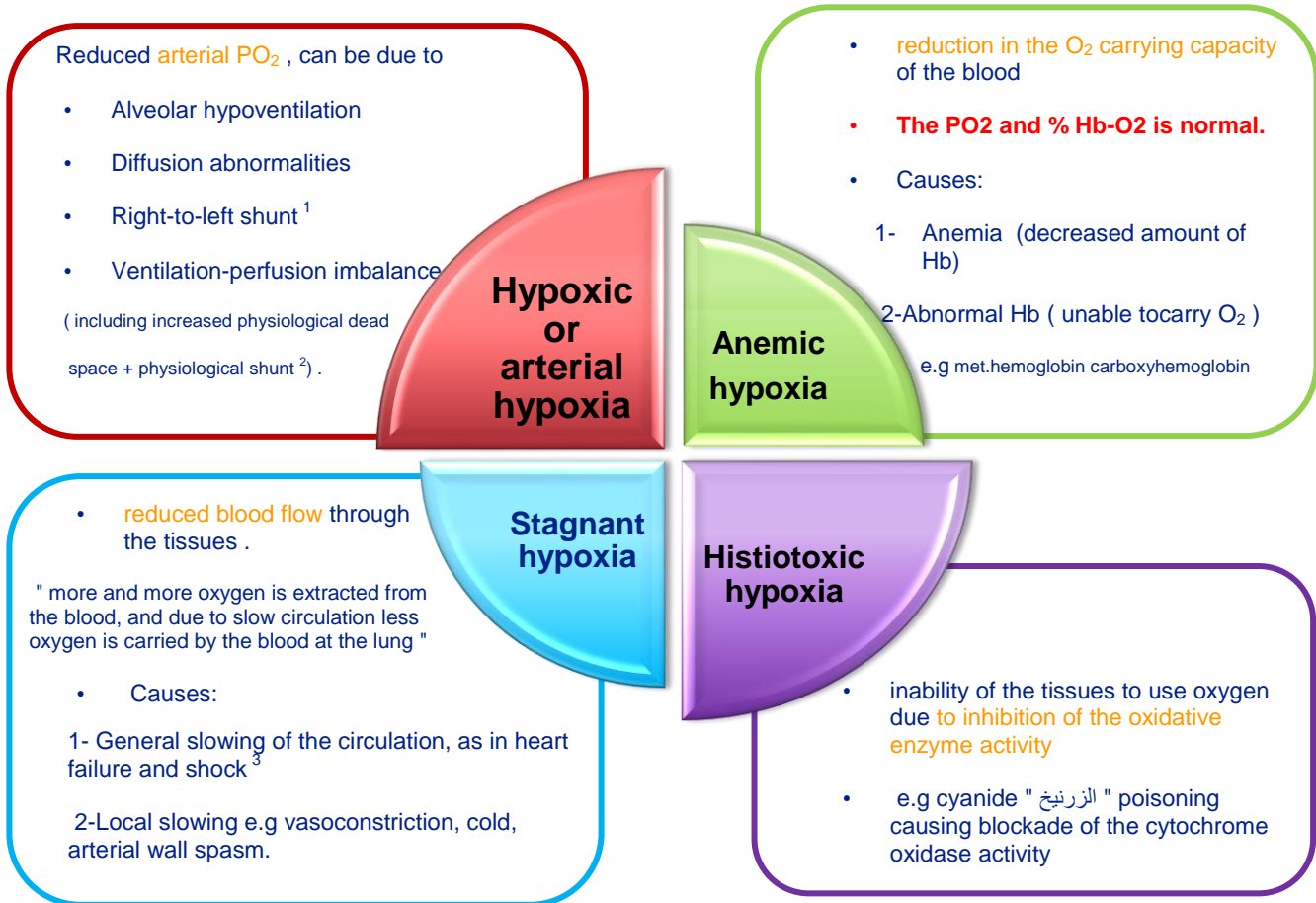
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COLOR INDEX:

- Red = important
- Grey = additional notes

1-HYPOXIA AND ITS CLASSIFICATION

Hypoxia : deficiency of oxygen in the tissue cells , It can be classified into the following groups:-



2-EFFECTS AND TREATMENT OF HYPOXIA

- According to the degree of hypoxia it could lead to :

- impaired judgment
- inability to perform complex calculations
- coma and death .
- Reduction in muscle working capacity
- headache,nausea, irritability (excessively sensitive to stimulus) , dyspnea,increased heart rate

- **TREATMENT OF HYPOXIA** : by giving oxygen therapy in a tent or high oxygen tension mask.

This is very useful in **hypoxic hypoxia**, but of less value in other types of hypoxia .

Histiotoxic hypoxia will not benefit from O₂ therapy.

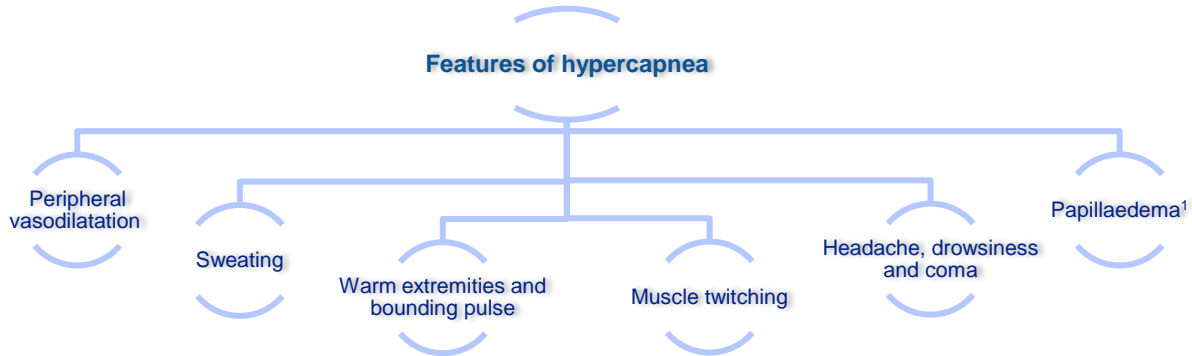


1- Right-to-left shunt occurs when there is an opening or passage between the atria, ventricles, and/or great vessels; and, right heart pressure is higher than left heart pressure and/or the shunt has a one-way valvular opening.
 2- Also called venous admixture , blood entering the arterial system without passing through ventilated areas of lung causing PO₂ in arterial to be less than alveolar
 3- Also called circulatory shock , find more about it here <http://medical-dictionary.thefreedictionary.com/circulatory+shock>

3-HYPERCAPNEA

Hypercapnea : excess CO₂ in body fluids, usually occurs with hypoxia .

N.B PCO₂ increases above 52 mmHg , decreases in PH (acidosis) !



4-CYANOSIS

Cyanosis : Blue discoloration of skin and mucus membrane due to more than 5 g/dl of deoxygenated hemoglobin in blood .

N.B Anemic patients almost never develop cyanosis due to low amount of Hb for 5 grams to be deoxygenated /100ml blood. conversely , in a patient with excess RBCs as in polycythemia vera great excess of Hb can be deoxygenated even under otherwise normal conditions leading to frequent cyanosis .

5- VENTILATION –PERFUSION RATIO (V/Q)

Definition

The ratio of alveolar ventilation to pulmonary blood flow per minute.

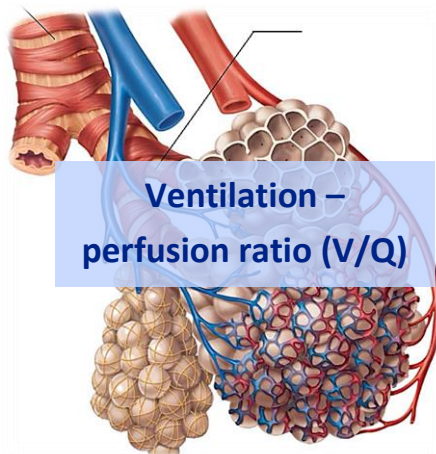
Alveolar ventilation at rest: 4.2 L/min

Pulmonary blood flow = right ventricular output per minute = 5L/min

Main function

to determine the state of oxygenation in the body.

Any mismatch in the ratio can result in hypoxia.



$$V/Q \text{ ratio across the lung} = \frac{4.2}{5} = 0.845$$

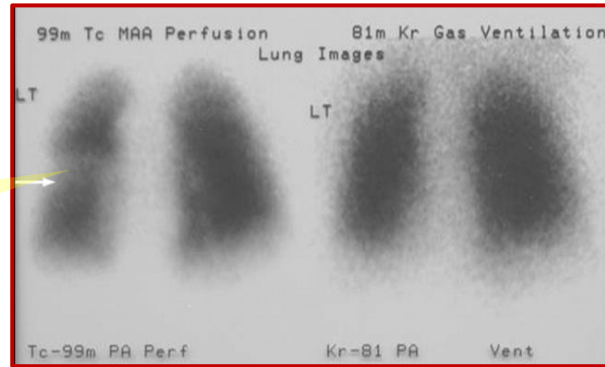
1- swelling of optic disc or optic nerve head

6-ABNORMALITIES OF THE V/Q RATIO

- ✓ At the base V/Q ratio=0.6 (i.e representing a physiologic shunt).
- ✓ At the apex V/Q ratio = 3 (i.e moderate degree of physiologic dead space)
- ✓ So we conclude that the apex is more ventilated than perfused and vice versa.

N.B During exercise the V/Q ratio becomes more homogenous among different parts of the lung

Ventilation- Perfusion Lung Scan



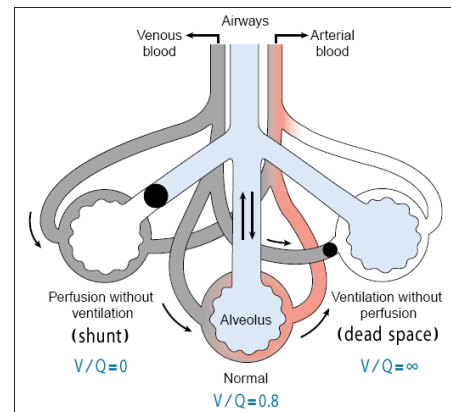
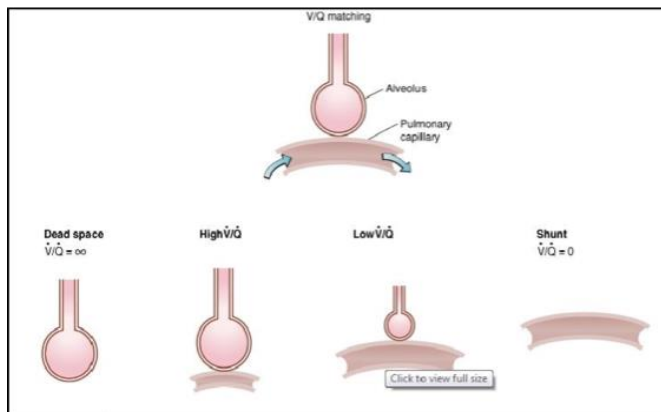
Indicates area of low perfusion



if the V/Q ratio is **less** than normal this is called **physiologic shunt** this happen when a certain fraction of the venous blood is passing through the pulmonary capillaries without being oxygenated i.e shunted blood

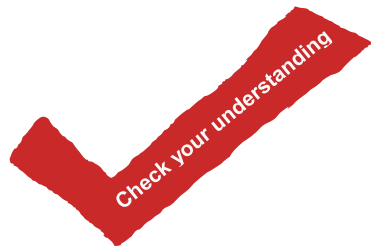


If the V/Q is **more** than normal this is called **Physiologic dead space** this happen when the ventilation of some of the alveoli is great but the alveolar blood flow is low so ventilation of these alveoli is wasted



** In Chronic Obstructive Lung disease (COPD).

Because of bronchial obstruction in some areas of the lung and destruction of the alveolar septa in other areas , some areas exhibit serious physiologic shunt and other areas serious physiologic dead space . and hence COPD is the most prevalent cause of pulmonary disability today cuz lung effectiveness as a gas exchange organ may decrease



V/Q mismatch & A-a gradient

(its about 15min and pretty detailed , I'd recommend it if you didn't get it)

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