University of Mosul
Lecture No.: 3
College of Veterinary Medicine
Date:
Unit of Scientific Affairs
Website: https://www.scopus.com/authid/detail.uri?authorId=57219363372

Lecture title: Partial pressures

Lecturer Affiliation: University of Mosul / College of Veterinary Medicine /

Department of Physiology, Biochemistry and Pharmacology

Summary: The approximate composition (and corresponding partial pressures) of dry atmospheric air at sea level (760 mmHg) is as follows: 20.93% O_2 (Po_2, 159 mmHg); 0.03% CO_2 (Pco_2) 0.23 mmHg); 79.0% N_2 (Pn_2, 600 mmHg)

- **Partial pressures**: -

The partial pressure of gas is a common concept associated with respiratory physiology. It may be **defined as** the pressure exerted by a given gas in a mixture of gases.

The approximate composition (and corresponding partial pressures) of dry atmospheric air at sea level (760 mmHg) is as follows: 20.93% O_2 (Po_2, 159 mmHg); 0.03% CO_2 (Pco_2) 0.23 mmHg); 79.0% N_2 (Pn_2, 600 mmHg). The equation for partial pressure is:

Pp = Pt x C

Pp = partial pressure of the individual gas

Pt = total pressure of the mixture of gas

C = the concentration of the individual gas

- Dalton's Law of Partial Pressure: - The total pressure of a mixture of gases equals the sum of all the partial pressures

P total = P1 + P2 + P3 + ……

- **Partial pressures of gases in the lungs, blood, and tissues**

1- Partial Pressure Changes of Oxygen

– The Po_2 of humidified inspired air is 150 mm Hg.

– The Po_2 of alveolar air is 100 mm Hg. This is due to the diffusion of O_2

from alveolar air into pulmonary capillary blood.
– The Po_2 of systemic arterial blood is 95 mm Hg. It is almost the same as the Po_2 of alveolar air because the partial pressure of pulmonary capillary blood equilibrates with alveolar air. However, ~2% of the cardiac output bypasses the pulmonary circulation, which accounts for the slight discrepancy in partial pressures.
– The Po_2 of venous blood is 40 mm Hg because O_2 has diffused from arterial blood into the tissues.

2-Partial Pressure Changes of Carbon Dioxide

– The Pco_2 of humidified inspired air is almost zero.
– The Pco_2 of alveolar air is 40 mm Hg because CO_2 from venous blood entering the pulmonary capillaries diffuses into alveolar air.
– The Pco_2 of systemic arterial blood is 40 mm Hg because pulmonary capillary blood equilibrates with alveolar air.
– The Pco_2 of venous blood is 46 mm Hg. It is higher than systemic arterial blood due to the diffusion of CO_2 from the tissues into venous blood following cellular respiration.

- **Dead space:** - is the volume of air that is inhaled and does not take part in the gas exchange, because it either remains in the conducting airways or reaches alveoli that are not perfused or poorly perfused. **In other words,** not all the air in each breath is available for the exchange of oxygen and carbon dioxide.
- **Anatomical dead space:** - is that portion of the airways (such as the mouth and trachea to the bronchioles) which conducts air to the alveoli, but do not take part in the process of gas exchange itself.
- **Alveolar dead space**: - refers to the volume of air in alveoli that are ventilated but not perfused, and thus gas exchange does not take place.
- **Physiological dead space:** - anatomical dead space + alveolar dead space.
- **Normal Dead Space Volume.** The normal dead space air in a young adult man is about **150** milliliters. This increases slightly with age.

- **<u>Pulmonary ventilation: -</u>** is the volume of gas moved in or out of the airways and alveoli over a certain period of time.
- PV= RR×TV
- Example: - when RR 12 breath / minute and TV 500ml

PV= 12×500
= 6000ml/minute

- Respiratory rate (RR): - number of breaths per minute.

Alveolar ventilation: The rate at which continually renew the air in the gas exchange reaches the alveoli, alveolar sacs, alveolar ducts, and respiratory bronchioles and because of the dead space, the volume of the air reaching the alveoli/min is always less than the pulmonary ventilation. This volume is termed alveolar ventilation.

Alveolar ventilation = R.R × (Tidal volume TV – Dead space)

12 × (500-150) ml/min.
12× 350 = 4200 ml /min