SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE TECHNOLOGY

COURSE NAME : PRINCIPLES OF PERFUSION TECHNOLOGY I

2nd YEAR

TOPIC : PRINCIPLES OF EXTRACORPOREAL GAS EXCHANGE

BLOOD GASES

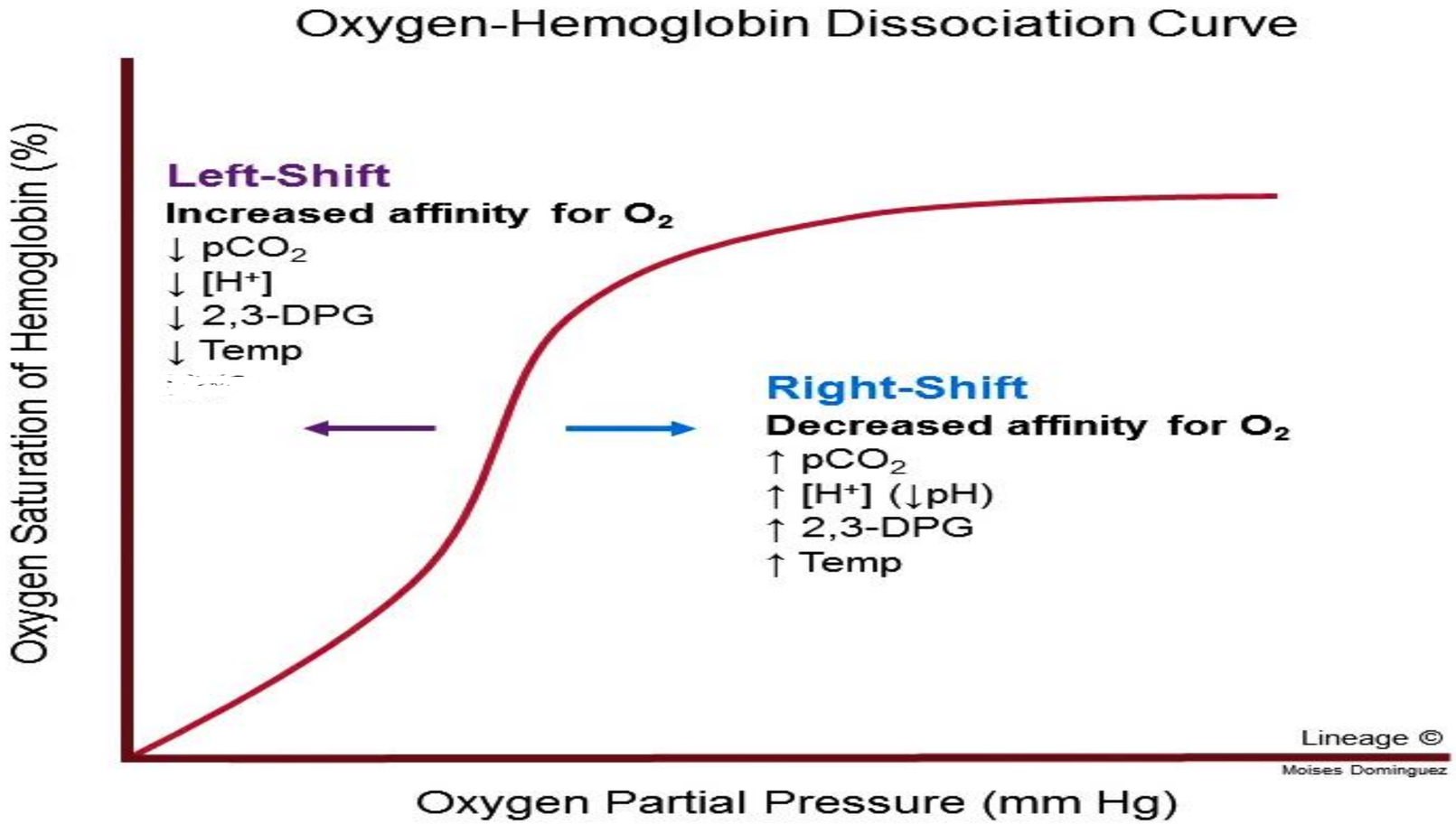
- The interpretation of the information contained in blood gas results is a major responsibility of the perfusionist
- Maintenance of homeostasis, the body's ability to maintain its normal physiology is greatly influenced by the gas exchange that occurs at the cellular level
- The first organ affected by inadequate oxygenation is the brain, other organs are affected soon thereafter
- The exchange of gas between the blood and cells of the tissues is known as internal respiration
- External respiration is the exchange of carbon dioxide and oxygen that takes place in the lungs or HLM

HEMOGLOBIN OXYGEN EFFECT

- Hemoglobin is the major portion of the red blood cell.
- Hemoglobin is responsible for transporting oxygen to the organs and tissues of the body
- About 97% of the bloods oxygen is transported by the hemoglobin
- The average adult has a basilar oxygen consumption rate of about 250ml/min
- The heart has a basilar oxygen consumption rate of 1.3ml/100gm of tissue per min
- The brain has a basilar O_2 consumption rate of 3.5ml/100gm of tissue per min
- Temperature affects the oxygen consumption
- For every 7°c that the temperature is lowered, the metabolic rate is decreased by 50% thus lowering the oxygen consumption
- The oxygen-carrying capacity of hemoglobin is influenced by pH, PCO2, temperature, concentration of 2,3- diphosphoglycerate (2,3-DPG), and the specific type of hemoglobin.

P50

- P50 is a reflection of a certain effect on the hemoglobin affinity for oxygen.
- The enzyme is measured is 2,3-DPG (2,3- Diphosphoglycerate)
- The term can be described as the oxygen tension when 50% of the hemoglobin is saturated at 37°c , PCO_2 40mmHg and PH of 7.40.
- Normal adult p50 (hemoglobin saturated at 50%) is 27mmHg under these conditions
- Decreased P50 indicates **increased affinity of Hb for oxygen**
- Increased P50 indicates **decreased affinity of Hb for oxygen**


Oxygen-Hemoglobin Dissociation Curve
Oxygen Saturation of Hemoglobin (%)
Left-Shift
Increased affinity for O2
↓ pCO2
↓ [H+]
↓ 2,3-DPG
↓ Temp
Right-Shift
Decreased affinity for O2
↑ pCO2
↑ [H+] (↓pH)
↑ 2,3-DPG
↑ Temp
Lineage ©
Moises Dominguez
Oxygen Partial Pressure (mm Hg)

O2 CALCULATIONS

- A fully saturated gram of hemoglobin can carry 1.34 ml of oxygen

- **OXYGEN CARRYING CAPACITY**

  O2 capacity =1.34* Hgb + .003 * pO2

- This formula assumes 100% saturation.
- Dissolved oxygen in plasma is found by pO2* .003
- It differs from the oxygen capacity in that it uses the actual O2 saturation
- **OXYGEN CONTENT**

  Content = 1.34* Hgb * % saturation (in decimal) + .003 * pO2

- **OXYGEN SATURATION**

  O2 saturation = O2 content / O2 capacity

O2 CALCULATIONS (cont)

- ON BYPASS – **OXYGEN CONSUMPTION**

  O2 consumption = aO2 content – vO2 content * flow(l/m)*10

- ON BYPASS – **OXYGEN TRANSFER**

  O2 transfer = (Art – Ven sat in decimal form * 1.34 * Hgb * flow(ml/min)/ 100

PERCENT	DECIMAL
60%	0.6
80%	0.8
90%	0.9
100%	1

PARTIAL PRESSURE OF GASES

- Atmospheric gases at sea level

GAS	% OF TOTAL	PARTIAL PRESSURE mmHg
OXYGEN	20.84	159
NITROGEN	78.62	597
CARBONDIOXIDE	.04	0.15
WATER	.5	3.85

- Partial pressure of alveolar air

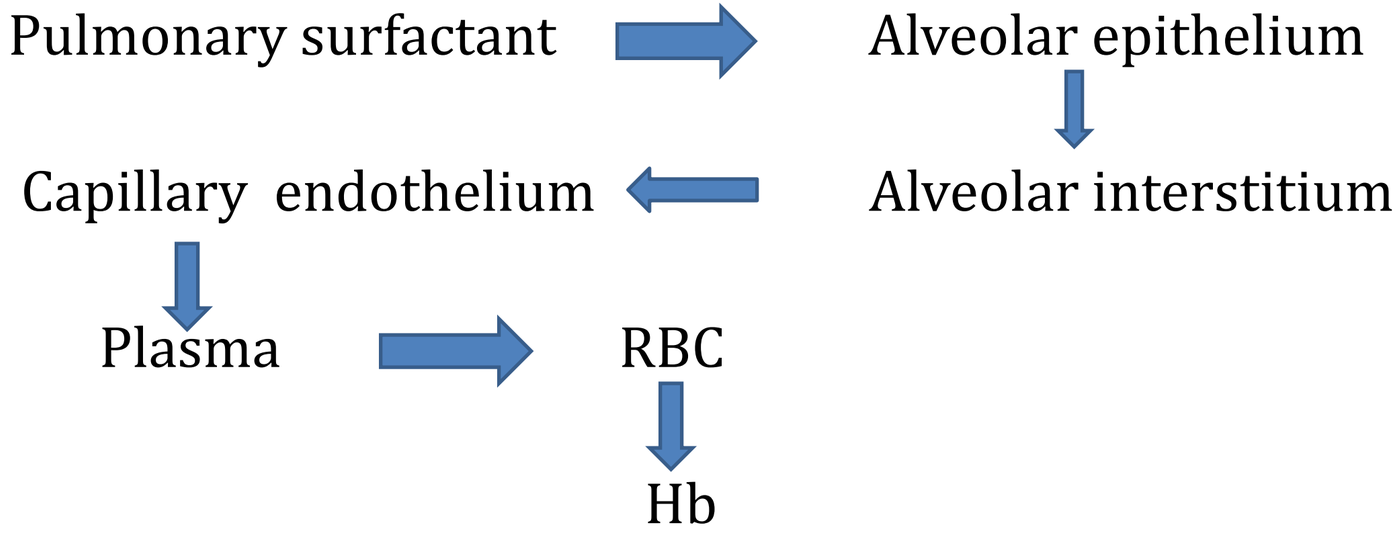
GAS	% OF TOTAL	PARTIAL PRESSURE mmHg
OXYGEN	13.6	104
NITROGEN	74.9	569
CARBONDIOXIDE	5.3	40
WATER	6.2	47

BLOOD GASES

PARAMETERS	ARTERIAL BLOOD GAS	VENOUS BLOOD GAS
pH	7.35 – 7.45	7.35 – 7.39
pO2	75 – 100 mmHg	38 – 42 mmHg
O2 saturation	96 -100%	73 – 77 %
pCo2	35 – 45 mmHg	44 -48 mmHg
BE	-2 to +2	-2.5 to +2.5
Bicarbonate	22 – 28 mEq/L	23 – 29 mEq/L

DIFFUSION

- It is the random motion of molecules in all directions through the respiratory membrane and adjacent fluids.
- Diffusion of oxygen from the alveoli into the pulmonary blood and diffusion of carbon dioxide from the blood into the alveoli .
- **DIFFUSION OF OXYGEN ACROSS THE ALVEOLAR WALL**



DIFFUSION (CONT)

DIFFUSION BETWEEN ALVEOLI &BLOOD

- Partial pressure of each gas in alveoli force molecules into solution
- Dissolved gases move from blood into alveoli proportional to their partial pressure

Rate of net diffusion is determined by difference of partial pressure

- If pp of gas in alveoli > blood then gas moves into blood(oxygen)
- If pp of gas in blood > alveoli then gas moves into alveoli (carbon dioxide)

Difference between Natural lung & Membrane oxygenator

Natural Lung	Membrane oxygenator
More surface area that helps in more oxygenation	Less surface area
It has a surface area of $70m^2$	It has a surface area of 0.5 to $4.0m^2$
Oxygen transfer is 2000 ml/min	Oxygen transfer is 400-600ml/min
Length 200µm	Length of blood path increase to get fully oxygenation so it is 2,50,000µm
Membrane thickness 0.5µm	Membrane thickness 150µm
Blood path width 8µm	Blood path width 200µm

THANK YOU