



**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**  
**II nd 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 blood's 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<sub>2</sub> 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



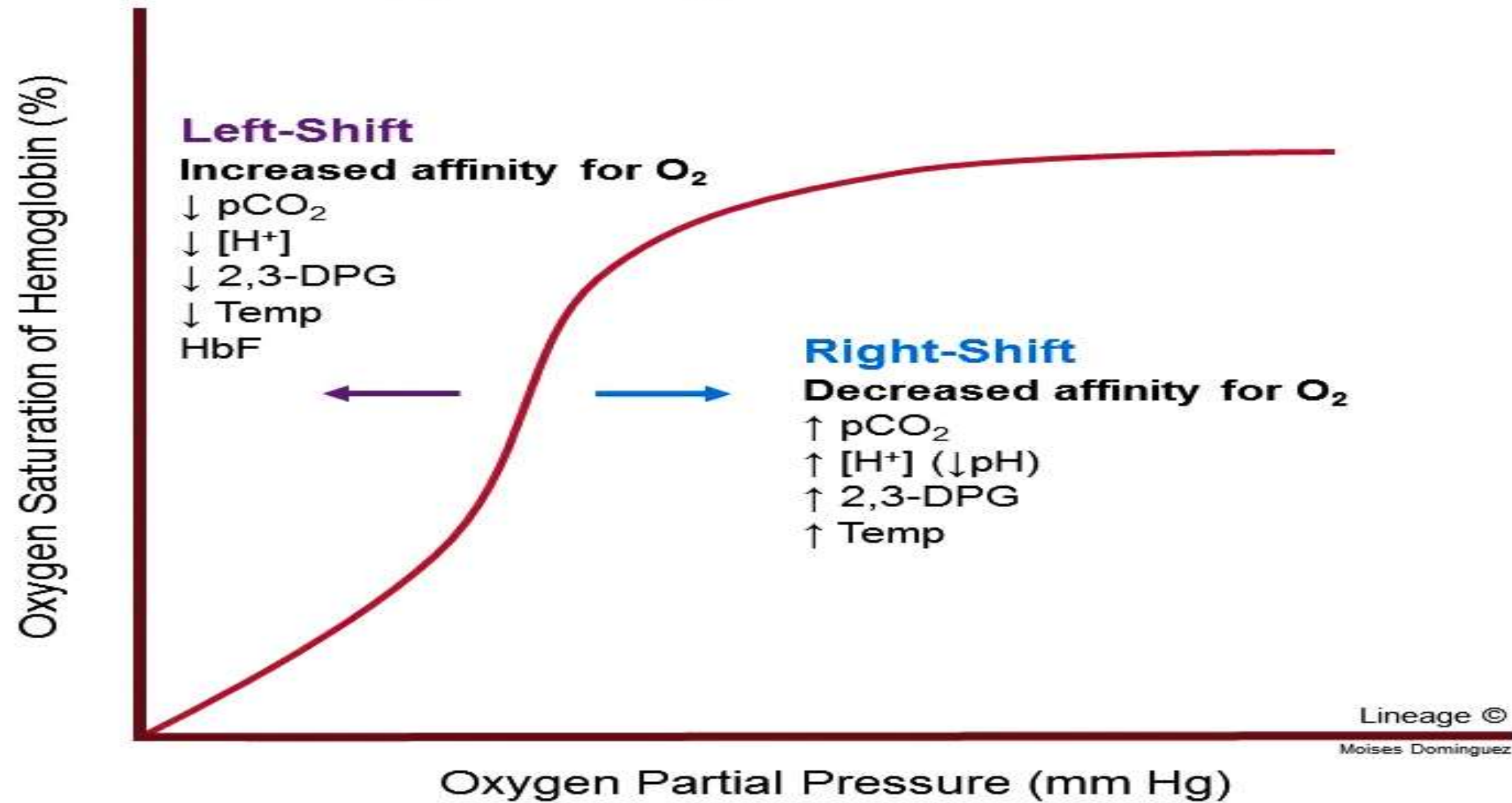
## P50



- P50 is a reflection of a certain effect on the hemoglobin affinity for oxygen.
- The enzyme is measured is 2,3 DPG
- The term can be described as the oxygen tension when 50% of the hemoglobin is saturated at 37° c , Pco2 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





## O2 CALCULATIONS

- A fully saturated gram of hemoglobin can carry 1.34 ml of oxygen
- **OXYGEN CARRYING CAPACITY**  
$$\text{O2 capacity} = 1.34 * \text{Hgb} + .003 * \text{pO2}$$
- This formula assumes 100% saturation. Dissolved oxygen in plasma is found by  $\text{pO2} * .003$
- It differs from the oxygen capacity in that it uses the actual O2 saturation
- **OXYGEN CONTENT**  
$$\text{Content} = 1.34 * \text{Hgb} * \% \text{ saturation (in decimal)} + .003 * \text{pO2}$$
- **OXYGEN SATURATION**  
$$\text{O2 saturation} = \text{O2 content} / \text{O2 capacity}$$



- **ON BYPASS – OXYGEN CONSUMPTION**

$$\text{O}_2 \text{ consumption} = \text{aO}_2 \text{ content} - \text{vO}_2 \text{ content} * \text{flow(l/m)} * 10$$

- **ON BYPASS – OXYGEN TRANSFER**

$$\text{O}_2 \text{ transfer} = (\text{Art} - \text{Ven sat in decimal form} * 1.34 * \text{Hgb} * \text{flow(ml/min)}) / 100$$

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



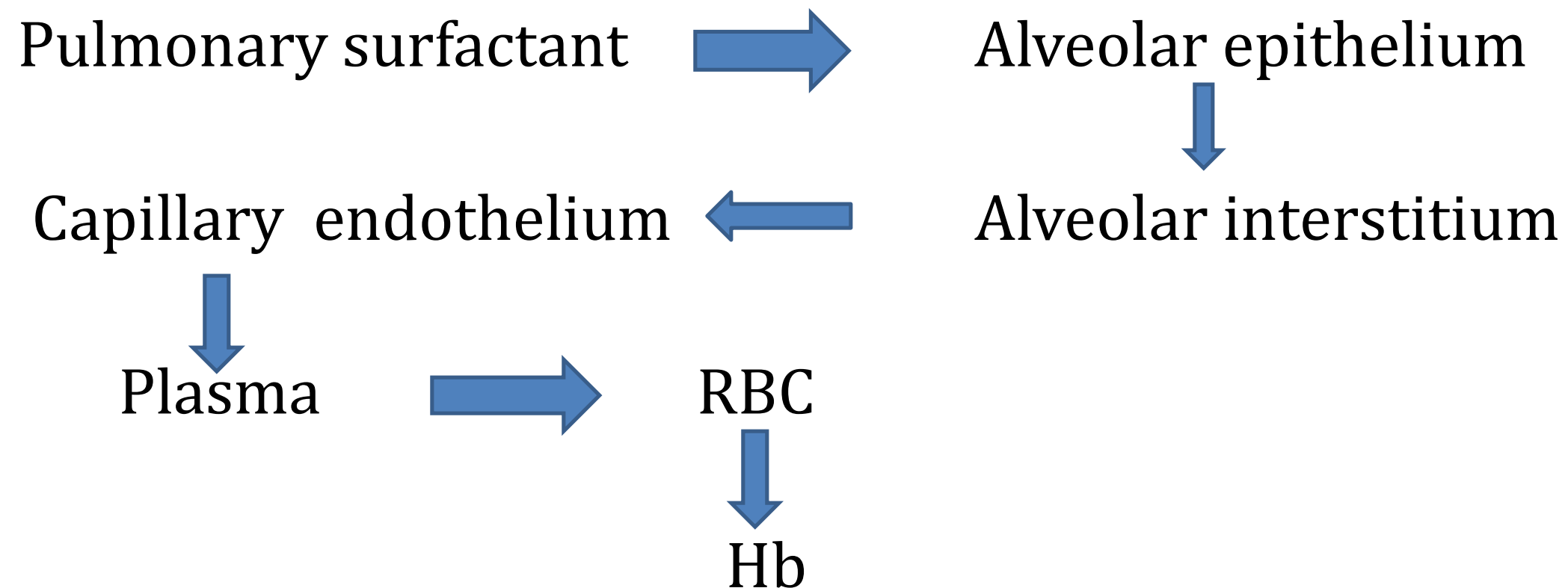
PARAMETERS	ARTERIAL BLOOD GAS	VENOUS BLOOD GAS
pH	7.35 – 7.45	7.35 – 7.39
pO <sub>2</sub>	75 – 100 mmHg	38 – 42 mmHg
O <sub>2</sub> saturation	96 -100%	73 – 77 %
pCo <sub>2</sub>	35 – 45 mmHg	44 -48 mmHg
BE	-2 to +2	-2.5 to +2.5
Bicarbonate	22 – 28 mEq/L	23 – 29 mEq/L



# 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 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)