# تفريغ كلينكال

المحاضرة: Acid- Base balanc "second

الصيدلاني/ة: Rahaf Zyoud

Soul Academy

لجان الدفعات

dec H+ / inc $HCO_3$

هسا لما الواحد يستفرغ ويطلع الH+ الجسم بده يستجيب فالامعاء (intestine )بتصير تطلع الHCO3- الموجودة فيها (loss) وهيك تقلل الalkalosis بس في حالة pyloric stenosis الintestion مارح تقدر تطلع الHCO3- منها وهيك قلت الH+ والHCO3- بتضل محبوسة

# Metabolic alkalosis

- The causes of a metabolic alkalosis may be due to:
  - Loss of hydrogen ion in gastric fluid during **vomiting**. This especially seen when there is pyloric stenosis preventing parallel loss of bicarbonate-rich secretions from the duodenum
  - **Ingestion of absorbable alkali:** such as sodium bicarbonate. Very large doses are required to cause a metabolic alkalosis unless there is renal impairment
  - **Potassium deficiency:** in severe potassium depletion as a consequence of diuretic therapy, hydrogen ion is retained inside cells to replace the missing potassium ions. In the renal tubules more hydrogen ions rather than potassium, are exchanged for reabsorbed sodium. So despite there an alkalosis, the patient passes an acid urine.

يستفرغ فيطلع $H^+$ الموجود بالمعدة

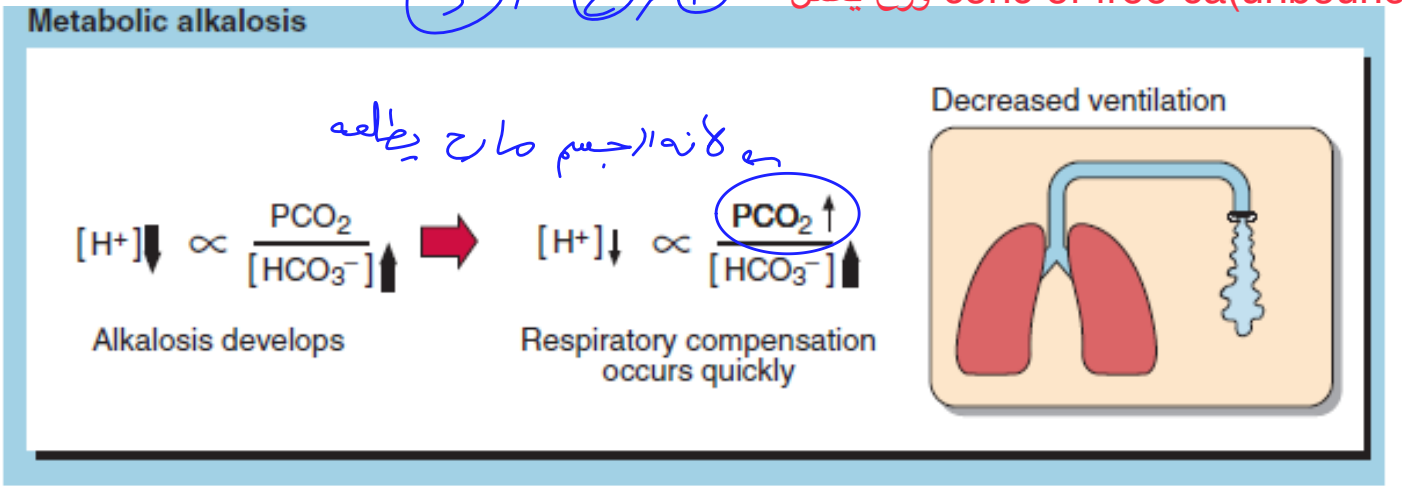
اذا الواحد عنده مشكله بال renal function واخذ absorbable alkali(دوا لحموضه المعدة)

# Clinical effects of alkalosis

اذا الجسم عنده potassium
deficincy رح يصير يدخل يدخل
الH+ الموجودة بالدم للخلايا عشان يعادل
الشحنه وهيك قلت الH+ بالجسم وصار
alkalosisال
بما انه عنده dec K+ ال tubule ما رح
تلاقي اشي تعمله excretion فبتدور
على cation قاني تطلعه بداله فمين
تطلع؟ رح تطلع الH+ بالبول

- The clinical effects of alkalosis include:
  - Hypoventilation عشان نحبس الـ $CO_2$ ويرجع الـ pH للوضع الطبيعي
  - Confusion and eventually coma
  - Muscle cramps, tetany and paraesthesia may be a consequence of a decrease in the unbound plasma calcium concentration. which is a consequence of the alkalosis.

بسبب ارتفاع الph ال ca رح ترتبط بالprotien بشكل اكبر وهيك قل
ال(conc of free ca(unbouned ورح يعمل



ال respiratory acodosis رح يادي
للmetabolic acidosis بس العكس
غير صحيح

# Respiratory acidosis

بكون عنده lung disease والlung
مش قادرة تطلع ال Co3

➢ **Lung disease:** in which CO2 is not effectively removed from the blood. In certain patients with chronic obstructive pulmonary disease (COPD, where CO2 is retained in the blood, causing chronic hypercarbia (elevated pCO2)

بكون عنده bronchopneumonia (التهاب بالقصبات الهوائية)ورح يتراكم افرازات والWBC وال bacteria جوا
الaleveoli وهيك رح تسكر او تتضيق وهيك رح hypoventilationوينحبس الCo3داخل ال lung

➢ In **bronchopneumonia:** gas exchange is impaired because of the secretions. White blood cells, bacteria and fibrin in the alveoli

➢ **Hypoventilation** caused by drugs such barbiturates, morphine, or alcohol will increase blood pCO2 levels

CNS-depression يعطو

Mechanical obstruction or asphyxiation (strangulation or aspiration).

? Decreases cardiac output such as in CHF also will result in less blood to the lungs for gas exchange
and an elevated pCO2

لا تنسوا زميلنا ايهم الله
يرحمه من دعائكم

# Respiratory alkalosis

بكون الواحد عنده decrease in oxegen ونتيجة ذلك بصير عنده hyperventilatio عشان يدخل الO2للجسم بس الCo2 اصلا وضعها طبيعي فبسبب الhyperventilation. الي صار الCO2 رح تطلع ويقل مستواها

- The causes include:
  - Hypoxemia انخفاض الo بالدم
  - Chemical stimulation of the respiratory center by drugs, such as salicylate
  - An increase in environmental temperature, fever, hysteria (hyperventilation), Pulmonary emboli and pulmonary fibrosis.

CNS stimulate

لو حلع

- The kidney compensates by excreting HCO3- in the urine and reclaiming H+ to the blood

كطلع الـ HCO3 من الجسم

بطلع الـ H+ من الخلايا للدم ← الـkidney رح تحاول تعدل الوضع عن طريق

- The popular treatment for hysterical hyperventilation, breathing into a paper bag, is self -explanatory

اذا الواحد عنده respiratory alkalosis بقدر يتنفس

بكيس عشان الـ Co2 كي يطلعه يرجع يتنفسه

# Oxygen and gas exchange
# Oxygen and carbon dioxide

الخليه بدها طاقة ومين بنتج هاي الطاقة ؟
الmitochondria طيب كيف تنتجها ؟عن طريق عمليات
الoxidation لل NADH والFADH2 ورح ينتج من هاي
العمليات pair of e طيب هذرل الe رح يضلو زي ما هنا
بالخلية؟اكيد لا فلازم ينحملو على الmolecular O فهذا
الدور الاساسي اله بدون الo الخلايا ما رح تنتج طاقة

➢ The role of oxygen in metabolism is crucial to all life. In cell mitochondria, electron pairs from the oxidation of NADH and FADH2, are transferred to molecular oxygen

➢ For adequate tissue oxygenation, the following seven conditions are necessary:

(1) available atmospheric oxygen الشخص يكون في مكان في O
(2) adequate ventilation لازم يكون قادر انه يتنفس عشان يقدر يدخل الo
(3) gas exchange between the lung and arterial blood
(4) Loading of O2 onto hemoglobin
(5) adequate hemoglobin
(6) adequate transport (cardiac output), and
(7) release of O2 to the tissue.

شو الشروط اللي لازم تكون موجودة عشان يكون في oxygenation كافي؟ من 1 لـ 7

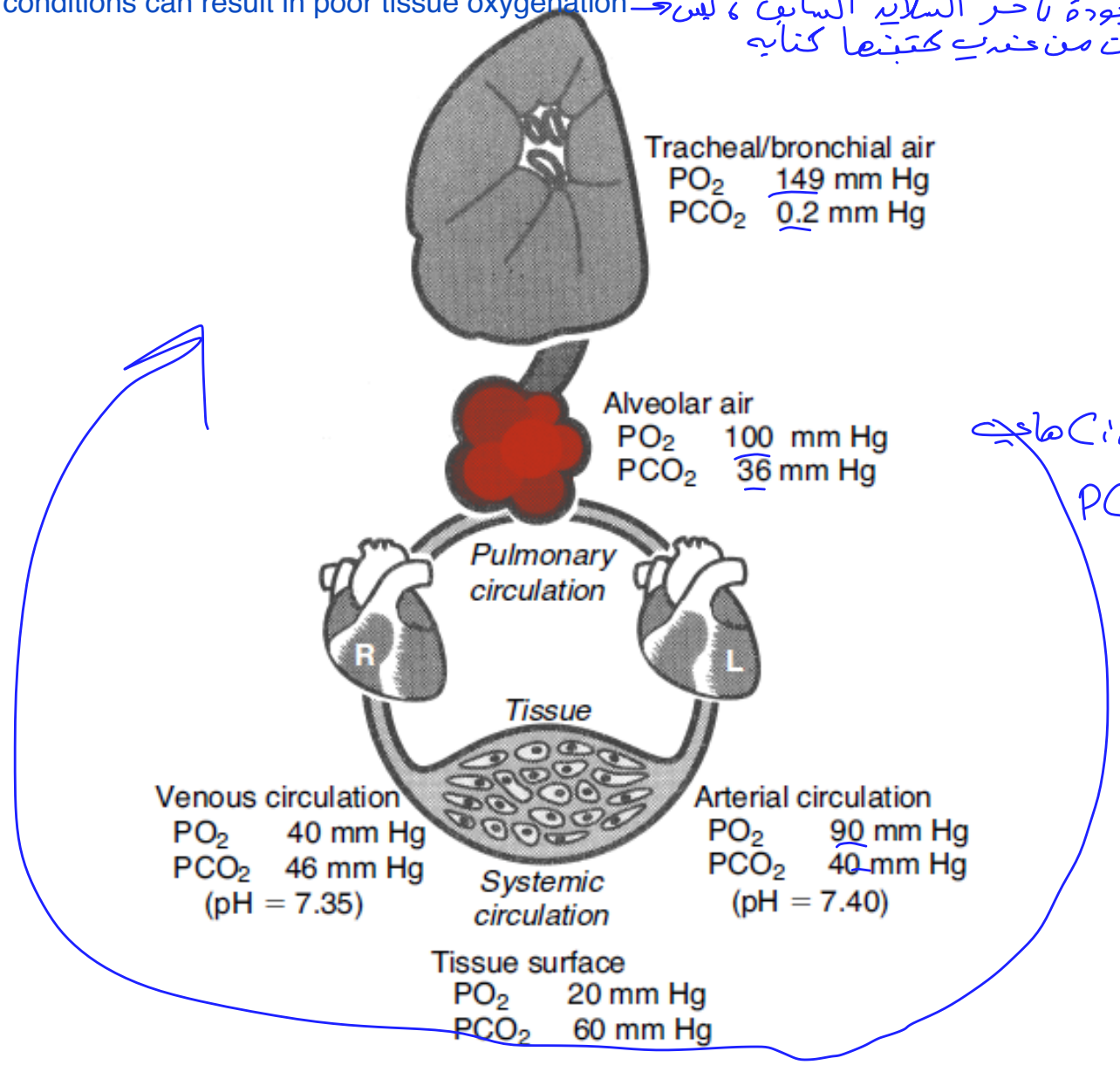
للجسم
الlung تعطي الarterial blood
الO والarterial blood يعطي
الlung الCo2

لازم الhemoglobin يكون قادر على تحميل الO وعنده عدد كافي من الhemoglobin

القلب لازم يضخ الدم بكميه كافية عشان الo يوصل الجسم
المحمل على الhemoglobin

اذا الخلية احتاجت الO تقدر تاخذه من الدم

Any disturbance in these conditions can result in poor tissue oxygenation



# Oxygen and carbon dioxide

شو المشاكل الي رح تخلي الO يقل

- Factors that can influence the amount of O2, that moves through the alveoli into the blood and then to the tissue include:

لو جبت alveoli وفردتها الsurface area الها قد ملعب تنس

- **Destruction of the alveoli:** the normal surface area of the alveoli is as big as tennis court. When the surface area is destroyed to a critical low value by diseases such as emphysema

اذا صارت مشكلة بالaleveoli ادت الى انه الsurface area الها يقل هذا رح يأدي الى decrease
بال gase exchange ومثال على هاي المشاكل الemphysema

- **Pulmonary edema:** Gas diffuses from the alveoli to the capillary through a small space. With pulmonary edema, fluid leaks into the space, increasing the distance between the alveoli and capillary walls

لما يمون في سوائل بالlung رح تزيد المسافة الي رح يقطعها ال O بين الaleveoli وبين ال capillary وهاي المسافة الي زادت رح رخ تعيق عمليه الgas exchange

- **Airway blockage.** Airways can be blocked, as in asthma and bronchitis

اذا الواحد انخنق لاي سبب ممكن يتشردق بالاكل او غيره وممكن يكون عنده امراض زي الasthma وال bronchitis الي رح يصير فيها افرازات بالرئة

- **Inadequate blood supply:** As in pulmonary embolism, pulmonary hypertension or a failing heart not enough blood is being carded away to the tissue where it is needed.

اذا الواحد عنده اي مشكله او مرض يؤدي الي انه الblood ما بيوصل للرئة بشكل كافي وهيك في مشكله
بالgas exchange وال cells رح تحتاج الO وهو مش قادرة تاخذه

- **Diffusion of CO2 and O2.** Because O2 diffuses 20 times slower than CO2, it is more sensitive to problems with diffusion. This type of hypoxemia is generally treated with supplemental O2. 60% or higher O2 concentrations must be used with caution because it can be toxic to lungs

ال diffusion لل Co2 اعلى بعشرين مره من ال diffusion لل O ،وال diffusion لل O كثير حساس اي اشي ممكن يأثر عليه لانه اصلا بطيء فاذا في مشكله بال Diffusion لل O بعطيه O(mask of O) وال conc اله يكون 60% او اكثر بس لازم انتبه عشان ما يكون في toxicity

# Oxygen transport

- Most O2 in arterial blood is transported to the tissue by hemoglobin.
- Each adult hemoglobin (A1) molecule can combine to four molecules of O2. reversibly with up to four molecules of O2

ال A1 hemoglobin يرتبط بـ O-oxygen

- The actual amount of O2 loaded depends on:
  - The availability of O2 → يكون في كميه O كافيه عشان ال hemoglobin يحملها
  - The concentration and type(s) of hemoglobin present [النوع يأثر على كميه O] كميه ونوع ال hemoglobin
  - The presence of interfering substances, such as (CO)

ال CO له affinity عاليه على ال hemoglobin فلما يرتبط على ال hemoglobin رح يخلي ال O ما تروح للخلايا [خلي ال affinity عالية]

  - The pH كل ما زادت ال pH زادت ال affinity للـ hemoglobin للـ O وصار زي تأثير ال CO
  - The temperature of the blood كل ما زادت الحرارة زادت الطاقة الحركية للـ O2 فرح يصير يتحرك بسرعة فلا hemoglobin صار تقدر تمسكه لفترة طويلة ↓ ال affinity عليه
  - The levels of PCO2 and 2,3- DPG.

كل ما زاد قلت ال affinity للـ O2 ال hemoglobin

يتم افرازه لما تكون ال affinity لل O على ال hemoglobin عالية عشان تقلل ال affinity وال O يقدر يروح للخلايا

# Oxygen transport

بالوضع الطبيعي يكون 95%من الfunctional hemoglobin مرتبط مع الO2

- With adequate atmospheric and alveolar O2 available and with normal diffusion of O2 to the arterial blood, more than 95% of the "functional" hemoglobin will bind O2.

لما بدي ازيد كميه كمية الO2 بالجسم (لما اعطي O )رح توصل نسبه الhemoglibin المرتبط بال O ل100% واي زيادة بال O بهد هيك رح يتحول لO dissolve(اكسجين ذائب بالدم)

- Increasing the availability of O2 to the blood further saturates the hemoglobin. However, once the hemoglobin is 100% saturated, an increase in O2 to the alveoli serves only to increase the concentration of dissolved O2 (dO2) in the arterial blood. This offers minimal increase in oxygen delivery.

اذا الواحد اهذ concعالي او ما التزم بالرقت الي لازم ياخذ الOفيه(ياخذ زيادة وقت) ممكن يصير عنده toxicity

- Prolonged administration of high concentration of O2 may cause toxicity and in some cases, decreased ventilation that leads to hypercarbia

# Oxygen transport

- Normally blood hemoglobin exists in one of four conditions:
  - Oxyhemoglobin (O2Hb), which is O2 reversibly bound to hemoglobin
  - deoxyhemoglobin (HHb; reduced hemoglobin), which is hemoglobin not bound to O2 but capable of forming a bond when O2 is available
  - Carboxyhemoglobin (COHb), Which is hemoglobin bound to CO. Binding of CO to Hb is reversible but is greater than 200 times as strong as that of O2
  - Methemoglobin (MetHb), which is hemoglobin unable to bind O2, because iron (Fe) is in an oxidized rather than reduced state. The Fe +3 can be reduced by the enzyme methemoglobin reductase, which is found in RBC's

➢ Co-oximeter are used to determine the relative concentrations (relative to the total hemoglobin) of each of these species of hemoglobin.

# Assessing a patient oxygen status

➢ Four parameters used to assess a patient's oxygen status are:

➢ Oxygen saturation (SO2)

➢ Measured fractional (percent) oxyhemoglobin (FO2Hb);

➢ Transcutaneous pulse oximetry (SpO2) assessments and

➢ The amount of O2 dissolved in plasma (PO2)

➢ Oxygen saturation (SO2) represents the ratio of O2 that is bound to the hemoglobin compared with the total amount of hemoglobin capable of binding O2

$$SO_2 = \frac{cO_2Hb}{(cO_2Hb + cHHb)} \times 100$$

# Oxygen saturation (SO2)

في software بساعدك تطلع الSO2، حيث بعطيه الpo2 والph وال temperture وهو بطلعلك

- Software included with the blood gas instruments can calculate SO2 from pO2, pH and temperature of the sample.

[O2HB / HHB]

- These calculated results can differ from those determined by direct measurement due to the assumption that only adult hemoglobin is present and the oxyhemoglobin dissociation curve has a specific shape and location

القانون الي رح نحسب منه الSo2 غير دقيق لانه في انواع ثانية من الHB
وما رح يبين اذا فيها مشكله

- These algorithms for the calculation do not account for the other hemoglobin species, such as COHb and MetHb

اي نوع HB غير ال adult-HB
بسمى dys HB

- So calculated SO2 should not be used to assess oxygenation status

# Fractional oxyhemoglobin

➢ Fractional (or percent) oxyhemoglobin (FO2Hb) is the ratio of the conc. of oxyhemoglobin to the conc. of total hemoglobin (ctHb)

$$FO_2Hb = \frac{cO_2Hb}{ctHb} = \frac{cO_2Hb}{cO_2Hb + cHHb + dysHb}$$

➢ Where the dysHb represents hemoglobin derivatives, such as COHb, that can't reversibly bind with O2 but are still part of the "total" hemoglobin measurement.

➢ These two terms SO2 and FO2Hb, can be confused because as the numeric values for SO2 are close to those of FO2Hb (differ in smokers and if dyshemoglobins are present)

# Partial pressure of oxygen dissolved in plasma

➢ Partial pressure of oxygen dissolved in plasma (pO2) accounts for little of the body's O2 stores.

ال freeO هو الال O الغير مرتبط باشي (dissolved in plasma) وبساهم بشكل بسيط بمخازن ال O بالجسم

➢ Noninvasive measurement are attained with pulse oximetry (SpO2). These devices pass light of two or more wavelength through the tissues of the toe, finger or ear.

يطلق ال wavelength لل O2Hb وال HHb على الاصبع فبتخترق ال capillary وتقيس نسبتهم في وممكن استخدم الاذن كمان

مشكله هذا الجهاز انه بقيس ال So2 واحنا حكينا شو مشكلته فوق

AHB

➢ The pulse oximeter differentiate between the absorption of light as a result of O2Hb and dysHb in the capillary bed and calculates O2Hb saturation. Because SpO2 does not measure COHb or any other dysHb, it overestimates oxygenation when one or more are present.

The accuracy of pulse oximetry can be compromised by many factors, including diminished pulse as a result of poor perfusion and severe anemia.

➢ The maximum amount of O2 that can be carried by hemoglobin in a

➢ given quantity of blood is the hemoglobin oxygen (binding) capacity. The molecular weight of tetramer hemoglobin is 64,458 g/mol.

➢ One mole of a perfect gas occupies 22,414 mL. Therefore, each gram of hemoglobin carries 1.39 mL of O2

$$\frac{22{,}414 \text{ mL/mol}_4}{64{,}458 \text{ g/mol}} = 1.39 \text{ mL/g}$$

➢ When the total hemoglobin (tHb) is 15 g/dL and the hemoglobin is 100% saturated with O2, the O2 capacity is:

$$15 \text{ g/100 mL} \times 1.39 \text{ mL/g} = 20.8 \text{ mL } O_2\text{/100 mL of blood}$$

total $O_2$ → $O_2$ dissolved in plasma + $O_2$ bound to hemoglobin

# Oxygen content

➢ Oxygen content is the total O2 in blood and is the sum of the O2 bound to hemoglobin (O2Hb) and the amount dissolved in the plasma (pO2)

bounded الاك بالجسم total صارح يعبرو عن الكمية ال
صارح بأثرو عليهم

➢ Because pO2 and pCO2 are only indices of gas-exchange efficiency in the lungs, they do not reveal the content of either gas in the blood.

هاي وظيفة ال $pCO_2, pO_2$

➢ If the pO2 is 100 mmHg, 0.3 ml of O2 will be dissolved in every 100 ml of blood plasma.

كلا 100ml من الدم رح يكون فيه 0.3ml ذائب فيها

$$0.3\ \text{mL} + (20.8\ \text{mL} \times 0.97) = 20.5\ \text{mL}$$

➢ The amount of [illegible] ificant.

The amount of dissolved O2 is usually not clinically significant. However, with low tHb or at hyperbolic conditions, it may become a significant source of O2 to the tissue. Normally 98-99% of the available hemoglobin is saturated with O2.

? Assuming a tHb of 15 g/dL, the O2 content for every 100 mL of blood plasma becomes

dissolved bound to Hb = total O2

$$0.3\ \text{mL} + (20.8\ \text{mL} \times 0.97) = 20.5\ \text{mL}$$

نسبة الـ saturated

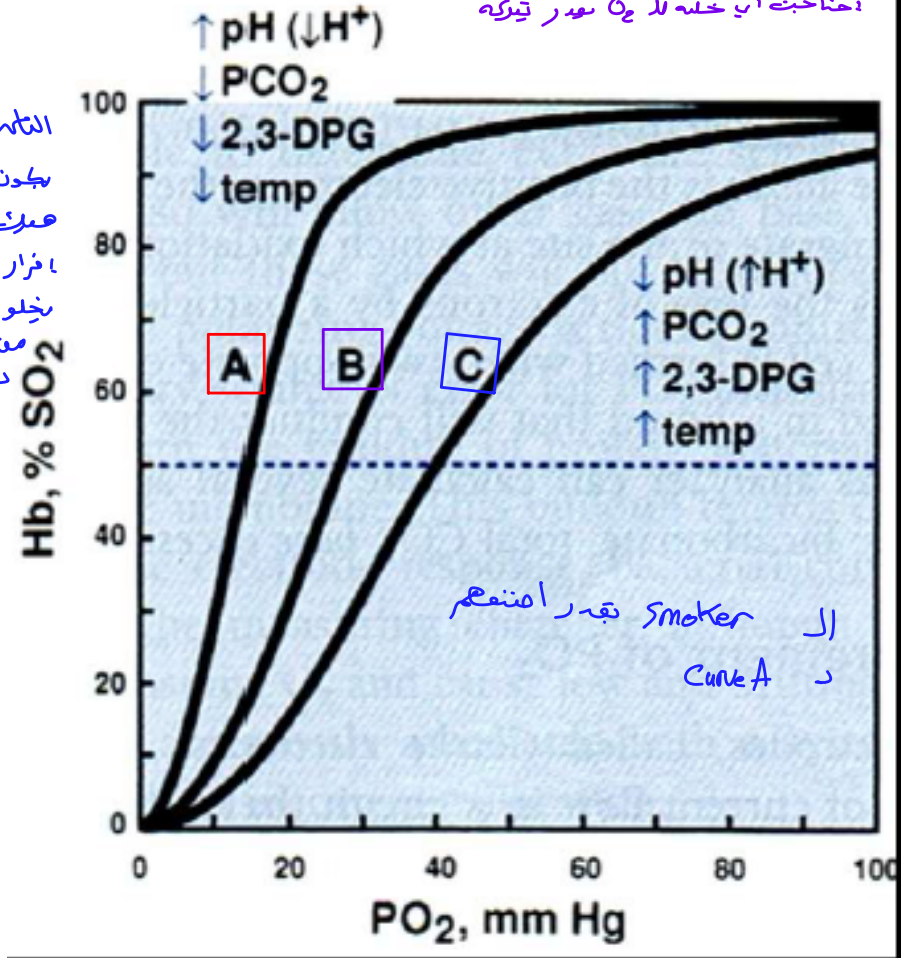
➢ The amount of ... ...ificant.

abnormality إذا الـ dissolved $O_2$ الجسم ما بستفيد كثير من الـ

زي

# Hemoglobin-oxygen dissociation

➢ 2,3-DPG levels increase in patients with extremely low hemoglobin values and as an adaptation to high altitude.



علاقة الـ $PCO_2$ بـ affinity عن طريق 2,3 DPG و Temp

↓

عكسية

علاقة الـ pH بـ affinity

↓

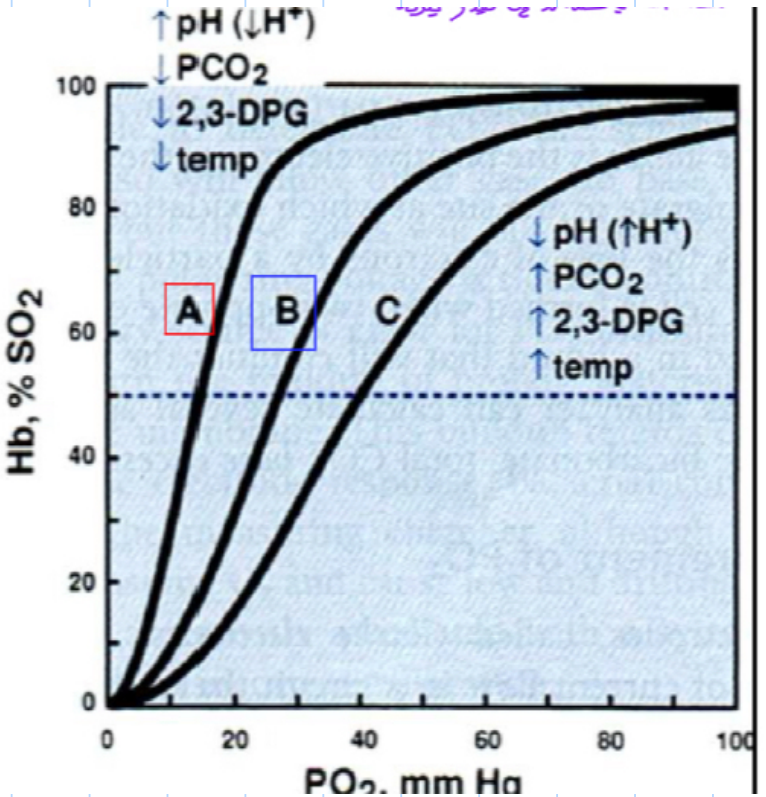
طردية

كلما كانت الـ pH قليلة، قلت الـ affinity لأن الـ $H^+$ الموجود بالدم رح يرتبط بأحد مواقع الـ Hb بدل الـ $O_2$، وهذا يعني لما احكي بيئة الدم حمضية يعني انه الـ $H^+$ نافس الـ $O_2$ وقعد محله على الـ hemoglobin

بينما لو حكيت انها قالية، يعني انه الـ Hb رح يرتبط فقط بالـ Hb high affinity

الـ $PCO_2$ كل ما قل زادت الـ affinity للهيموغلوبين لأنه الـ Hb رح يحمل $O_2$ بس والـ $CO_2$ مارح تقدر تنافسه

بس لو كان الـ $PCO_2$ عالي، الـ $CO_2$ رح تنافس الـ $O_2$ على الـ Hb وصيت تقل الـ affinity




الـ 2,3DPG هي المسؤولة عن كمية الـ $O_2$ بالجسم تقلل الجسم رح يستجيب ويفرز الـ 2,3DPG عشان يحرر الـ $O_2$ المرتبط بالـ Hb فيك وباختصار الجسم ليستفيد منه، يعني تقلل الـ affinity

اول جمله بالسلايد الجاي بس داخله يعني عشان هيك حطيتها هون

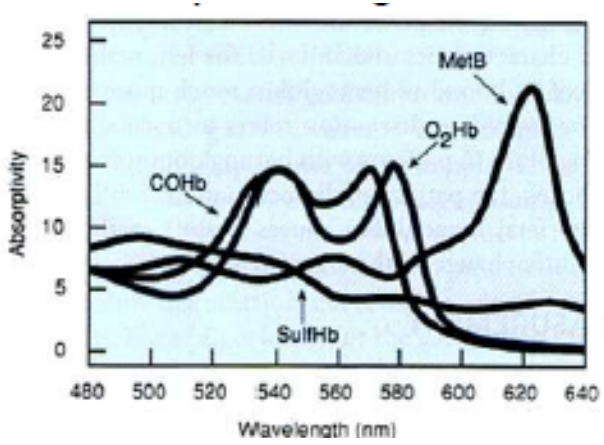
The actual determination of oxyhemoglobin (O2HB) can be determined spectrophotometrically using co-oximeter designed to directly measure the various hemoglobin species.

# Measurement

## Spectrophotometric (Co-oximeter) Determination of oxygen saturation

➢ The actual determination of oxyhemoglobin (O2Hb) can be determined spectrophotometrically using co-oximeter designed to directly measure the various hemoglobin species.

➢ The number of hemoglobin species measured will depend on the number and specific wavelength incorporated into the instrumentation. For example, two wavelength instrument systems can measure only two hemoglobin species (O2Hb and HHb), which are expressed as a fraction or percentage of the total hemoglobin.



# Spectrophotometric (Co-oximeters) Determination of oxygen saturation

- As with any spectrophotometric measurement, potential sources of errors exist, including:
  1. Faulty calibration of the instrument
  2. Spectral-interfering substances
- The patient's ventilation status should be stabilized before blood sample collection
- An appropriate waiting period before the sample is redrawn should follow changes in supplemental O2 or mechanical ventilation
- All blood samples should be collected under anaerobic conditions and

and mixed immediately with heparin or other appropriate anticoagulant.

- If the blood gas analysis is not being done on the same sample, EDTA can be used as an anticoagulant

- All samples should be analyzed promptly to avoid changes in saturation resulting from the use of oxygen by metabolizing cells

# Blood gas analyzers (pH, pCO2 and pO2)

- Blood gas analyzers (macroelectrochemical or microelectrochemical sensors) as sensing devices

- The pO2 measurement is amperometric (current flow) related to the amount of O2 being reduced at the cathode

- The PCO2 and pH measurement are potentiometric (change in voltage)

- The blood gas analyzer can calculate several additional parameters, bicarbonate, total CO2, base excess and SO2.

# Measurement of pO2

الجيتيه فيها protien كتير بسكر على membrane
إلي حول ال electrod وصلك ال $O_2$ طارح يقدر يدخل

- The primary source of error for pO2 measurement is associated with the buildup of protein material on the surface of the membrane (retards diffusion of O2)

اذا الجيتيه فيها بكتيريا ممكن تستهلك ال $O_2$ هم

- Bacterial contamination within the measuring chamber, although uncommon, will consume O2 and cause low and drifting values

- It is important not to expose the sample to the room air when collecting, transporting and making O2 measurement.

لأنه ممكن تختلط مع الدم

result in significant error

- Contamination of the sample with room air (pO2, 150 mmHg) can

Even after the sample is drawn, sample should by analyzed immediately as leukocytes continue to metabolize O2 leading to low PO2 value

إذا ما تراحت العينة وقت الـ WBC رح تستهلك الحنية

# Measurement of pO2

- Cutaneous measurement for pO2 also are possible using transcutaneous (TC) electrodes placed directly on the skin.

يكون الـ electrod على شكل لاصق بنحطه على الجلد و بقيس الـ $PO_2$

- Measurement depends on oxygen diffusing from the capillary bed through the tissue to the electrode. Although most commonly used with neonates and infants

- Skin thickness and tissue perfusion with arterial blood can significantly affect the results.

thickness + tissue perfusion الـ electrod المكان اللي رح احط عليه الـ رح يأثر على القراءة

- Heating the electrode placed on the skin can enhance diffusion of the

to the electrode, however, burns can result unless the electrodes are moved regularly

في بعض الحالات ممكن نسخن الـ electrod حتى نحسب الـ diffusion of $O_2$ اذا ما بدنا ممكن ينحرق الـ electrod

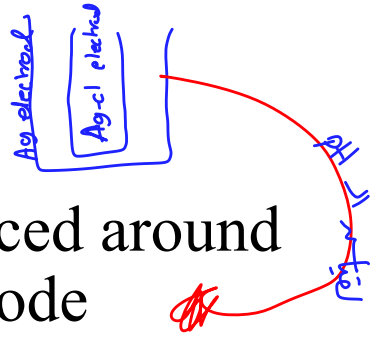
# Measurement of pH and pCO2

- Two electrodes (the measuring electrode responsive to the ion of interest and the reference electrode) are needed and voltmeter, which measures the potential difference between the two electrodes.

كلما كان فرق الجهد اعلى كان الـ error اقل

- The potential difference is related to the concentration of the ion of interest.

بستخدمة لقياسه الـ pH، حيث $H^+$ رح تنتقل لهذا الـ electrod من داخلية فكلما زاد انتقال الـ $H^+$ زاد فرق الجهد وبعدها بجرن فرق الـ pH




- To measure pH, a glass membrane sensitive to H+ is placed around an internal Ag-AgCl electrode to form a measuring electrode

- The potential that develops at the glass membrane as a result of H+ from

the unknown solution diffusing into the membrane's surface is proportional to the difference in [H+] between the unknown sample and the buffer solution inside the electrode

# pCO2

$H_2CO_3 \rightarrow H^+ + HCO_3^-$

➢ An outer semipermeable membrane that allows CO2 to diffuse into a layer of electrolyte, usually bicarbonate buffer, covers the glass pH electrode. The CO2 that diffuses across the membrane reacts with the buffer, forming carbonic acid, which then dissociates into bicarbonate plus H+

➢ The change in the activity of the H+ is measured by the pH electrode and related to pCO2

➢ As with the other electrodes, the buildup of protein material on the membrane will affect diffusion and cause errors, pCO2 electrodes are

slowest to respond because of the chemical reaction that must be completed. Other error sources include erroneous calibration caused by incorrect or contaminated calibration materials

هاي الطريقة بطيئة لانه بدي استنى لل الـ $CO_2$ تتحول لـ $H_2CO_3$ وبعدين تتحول لـ $HCO_3^- + H^+$

# Specimen

- Arterial blood specimen is an excellent reference

$O_2$ transport و Pulmonary function اذا ما بدي اقيس الـ Perphral venous ممكن استخدم الـ

- Peripheral venous samples can be used if pulmonary function or O2 transport is not being assessed (the source of the specimen must be clearly identified)

لازم احكي مين وين اخذت العينة

- Depending on the patient, capillary blood may need to be used to measure pH and pCO2

- Although the correlation with arterial blood is good for pH and pCO2, capillary pO2 values even with warming of the skin before

Although the correlation with arterial blood is good for pH and $pCO_2$, capillary $pO_2$ values even with warming of the skin before drawing the sample, do not correlate well with the arterial $pO_2$ values as result of sample exposure to room air

Sources of error in the collection and handling of blood gas specimens include the collection device, form and concentration of heparin, speed of syringe filling, maintenance of the anaerobic environment, mixing of the sample to ensure dissolution and distribution of the heparin anticoagulant, and transport and storage time before analys

تابعوا التيلجرام لأي تعديل

# Interpretation of results

- Laboratory professionals need certain knowledge, attitude and skills for obtaining and analyzing specimens for pH and blood gases.
- Simple evaluation of the data may reveal an instrument problem (possible bubble in the sample chamber or fibrin plug)
- A possible sample handling problem (PO2 out of line with previous results and current inspired FiO2 levels)
- The application of knowledge saves time. The ability to correlate data quickly reduces turnaround time and prevents mistakes.