Chloride

- The major extracellular anion
- Function in body:
  - Maintaining osmolality
  - Blood volume and
  - Electric neutrality
- Cl is usually shifted according to Na and bicarbonate
- Excess chloride in the body is excreted in urine and sweat, excessive sweating will induce the release of aldosterone which will conserve Na and Cl

$H^+ + HCO_3^- \leftarrow H_2O + CO_2$

diffusion

RBC الـ خارج الـ blood مين لازم يعوضوا الـ ا ك ويدخل على الـ

وهاد لما يصير acidosis ... الكلور

135-145 الصوديوم 97-107

(29-23) الـ HCO_3

فالصوديوم ما يصير اي

عليه نهاي الحالة..

Chloride

- Chloride maintains electrical neutrality in two ways:
- Na is reabsorbed along with Cl in the proximal tubules. Na reabsorption is limite amount of Cl- available
- Electroneutrality is also maintained by chloride through the chloride shift.
  - Carbon dioxide generated by cellular metabolism within the tissue diffuses out into b plasma and the red cells
  - In the red cell, CO2, forms carbonic acid (H2CO3), which splits into H+ and HCO3- (bicarbonate).
  - Deoxyhemoglobin buffers H+, whereas the HCO3- diffuses out into the plasma and (diffuses into the red cell to maintain the electric balance of ..

- Chloride disorders are often the result of the same causes that disturb Na leve because chloride passively follows Na
- There are a few exceptions.
  - Hyperchloremia may also occur when there is an excess loss of bicarbona result of GI losses, RTA or metabolic acidosis
  - Hypochloremia may occur with excessive loss of chloride from prolonged v diabetic ketoacidosis, aldosterone deficiency or salt-losing renal diseases.
  - A low serum level of chloride may be encountered in conditions associated serum bicarbonate concentrations such as compensated respiratory acidosi metabolic alkalosis.

Determination of the chloride

- Specimen: serum or plasma, whole blood samples, urine (24-hr) or sweat may be used
- Lithium heparin is the anticoagulant of choice.
- Hemolysis does not cause significant change in serum or plasma values as a result of decreased levels of intracellular chloride (marked hemolysis, decrease due to dilutional effect). ← زي الصوديوم
- Methods: there are several methodologies includes:
  - ISE (most commonly used where an ion-exchange membrane is used to selectively bind Cl ions) ← أدق وأغلى وحدة
  - Amperometric coulometric titration
  - Mercurimetric titration
  - Colorimetry
- Amperometric coulometric titration method using coulometric generation of silver ions (Ag which combine Cl to quantitate the Cl ion concentration
- $Ag^+ + Cl^- \longrightarrow AgCl$ ← من مقدار التحول الكهرباء

HCO_3^-

Bicarbonate

- Is the second most abundant anion in the ECF
- The total CO2 comprises the bicarbonate (90%), carbonic acid and dissolved total CO2 measurement is indicative of HCO3- measurement
- Bicarbonate is the major buffering system in the blood where carbonic anhydr RBCs converts CO2 and H2O to carbonic acid

$$CO_2 + H_2O \xleftrightarrow{CA} H_2CO_3 \xleftrightarrow{CA} H^+ + HCO_3^-$$

- Bicarbonate diffuses out of the cells in exchange for chloride to maintain ionic neutrality within the cell

ـ الـregulation عن طريق الكلى اذ الكلى تمكن الكلى تسوي بطيئة اذ الكميات كبيرة لكن بقدر أحينه H^+ يرجعوا على شكل Co_2 ويطلع عن طريق التنفس..

↑ Co_2 ↑ Hypervet

↓ Co_2 ، ↓ Hypovet

Bicarbonate regulation

- Most of the filtered bicarbonate ion is reabsorbed in the kidneys (85% in proximal and 15% in the distal) in the form of CO2 (due to low permeability of tubules to bic
- Normally nearly all the bicarbonate ions are reabsorbed from the tubules, with little urine
- When bicarbonate ions are filtered in excess of hydrogen ions available, almost all HCO3- flows into the urine.
- In alkalosis, with relative increase in bicarbonate ion compared to CO2, the kidneys excretion of HCO3- into the urine, carrying along a cation such as sodium. This los HC3O- from the body helps correct pH
- In acidosis, the excretion of H into the urine is increased and HCO3- reabsorption is complete

Hypokalemia

..... ↓ HCO_3^- يتعدل

alkalosis, ↓ H^+, ↓ K^+

Clinical applications

- Acid-base imbalances cause changes in bicarbonate and CO2 levels. A decreased bicarbonate/ CO2 occurs in metabolic acidosis leads to exhalation of CO2 by the lungs (hyperventilation), which lowers pCO2.
- Elevated total CO2 concentrations occur in metabolic alkalosis as bicarbonate is retained, often with increased pCO2, as a result of compensation by hypoventilation.
- Typical causes of metabolic alkalosis include:
  - Severe vomiting
  - Hypokalemia
  - Excessive alkali intake

bicarbonate ← لازم تكون العينة مسكرة مزبوط لأنو يخف
موجود على شكل CO_2

Method

هون قديش عندي بالعين bicarbonate بدو يحلل oxaloacetate

- HCO3 is used to carboxylate phosphoenolpyruvate (PEP) of phosphoenolpyruvate (P carboxylase, which catalyzes the formation of oxaloacetate.

$$\text{Phosphoenolpyruvate} + HCO_3^- \xrightarrow{\text{PEP carboxylase}} \text{Oxaloacetate} + H_2PO_4^- \qquad \text{(Eq. 15-4)}$$

- This is coupled to the following reaction, in which NADH is consumed as a result of the malate dehydrogenase (MDH)

(340nm) NADH بتقيس الـ absorb ← أي زيادة فيه معنا HCO3 زادت

$$\text{Oxaloacetate} + NADH + H^+ \xrightarrow{\text{MDH}} \text{Malate} + NAD^+ \qquad \text{(Eq. 15-5)}$$

- The rate of change in the absorbance of NADH is proportional to the concentration of

Reference ranges

- Carbon dioxide, venous 23-29 mmol/L (plasma, serum).

Mitocardial بالـ anearobic نتيجة hypoxia الـ بنتج من lactate ←
respiration

lactate ← pyruvate ← GluCose

Lactate

بوصل لـ liver بتحول لـ
GluCose وبتصنع الـ pyruvate بتحول
للـ GluCose وبروح على الدم ... RBC

- Lactate is a by-product of an emergency mechanism that produces a small amo ATP (2 moles)

← هاالحفزدهن بس عشان كمية صغيرة من RBC الـ liver لكنه مع بزيد
لما ينقص الـ oxygen كالخلايا بتتحول الـ anearobic وهو أسرع من PH
كتياس

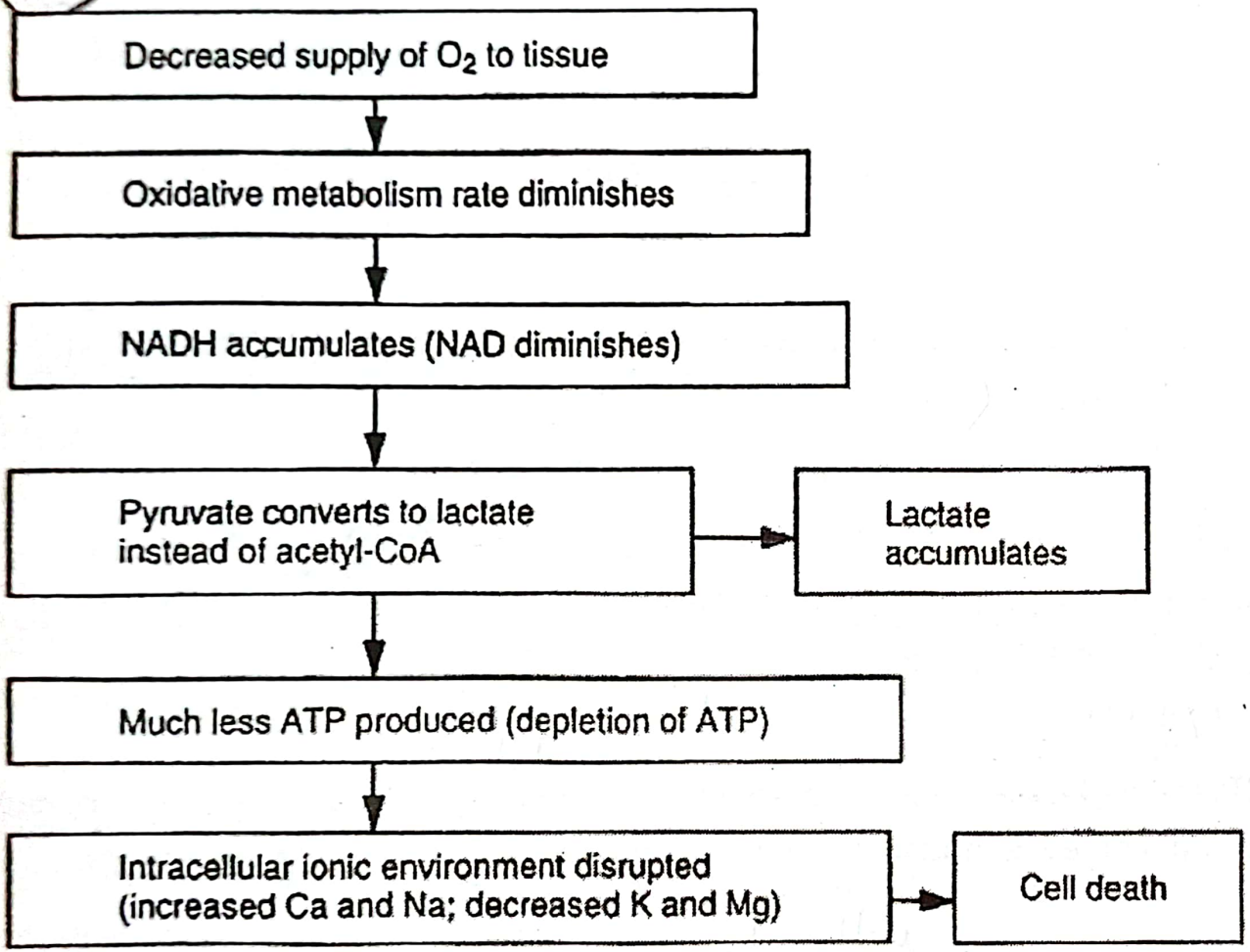
- Under hypoxic conditions, acetyl CoA formation does not occur and NADH accur favoring the conversion of pyruvate to lactate through anaerobic metabolism.

← بنعطى بالعيانة الكركزة بنعيس هو...

- The accumulation of excess lactate in blood is an early sensitive and quantitative indicator of the severity of oxygen deprivation (more than pH)

ما في oxygen معناه NADH بيلش بيلش شو
الـ cribs ↓ وبروح الـ pyruvate لطريق
cycle
2Atp ... ↑lactate Lactate الـ

بنتج بس بنصير في خلل بالأنزيمات
(سرع الأكسيد الـ)



الحاجة اللي بنحطها في test tube عشان تنشط طاي العملية

Fluride