Biochemistry
Team 434

Lactic Acidosis

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Objectives:

- Introduction to metabolic acid-base disorders
  - Metabolic acidosis and alkalosis
- Lactic acidosis
  - Definition
  - Lactate metabolism in tissue
  - Mechanisms involved in lactic acidosis
  - Types and causes of lactic acidosis
  - Diagnosis and treatment

Color index:

- Important
- Explanation
- Extra Notes

Abbreviations:

ECF=Extracellular Fluid
Conc.=Concentration.
HCO3=Bicarbonate Ions.
Cations: positively charged.
Anions: negatively charged.

Metabolic acid-base disorders:

Definition..?

Disorders happen due to changes in bicarbonate conc. in (ECF).

Causes..?

Occur due to high conc. or loss of H^+ ions

Could lead to..?

- Metabolic acidosis
- Metabolic alkalosis*

WHY BICARBONATE?? because it's the main physiological buffer, which maintains PH and resist it's change. (high amount of H^+ will react with bicarbonate and will produce CO2.

*Discussed in next slide but,

Before you go through the next you should know the meaning of

1.Diabetic ketoacidosis:

There's insulin resistance, so instead of burning glucose,It Burns Fatty acids→ketone bodies→Acidosis.

2. Renal tubular acidosis:

Normally urine is alkaline, but in this case: high amount of Na enters and then K will get out of the cell, and also hydrogen ions will get out so it will not be excreted which leads to (acidosis).

	Metabolic acidosis • Elevated H^+. • Decreased HCO3 in ECF. • Elevated K^+.	Metabolic alkalosis • Decreased H+ • Elevated HCO3 in ECF. • Decreased K^+.
Causes.	1. ↑production of H^+ ions. 2. Impaired excretion of H^+. 3. Ingestion of H^+ or drugs metabolized to acids.	1. Loss of H^+ ions in gastric fluid due to vomiting 2. Ingestion of sodium bicarbonate. 3. K^+ deficiency as a result of diuretic therapy."to Hypertension patients"
In patients with..	• Renal disease • Diabetic ketoacidosis • Lactic acidosis • Chronic diarrhea • Poisoning • Renal tubular acidosis	
Clinical effects..	• ↑H^+ conc. stimulates respiratory response. • Hyperventilation (stimulated respiration)Deep, rapid, gasping respiration (kasmaul's Respiration**) compensates acidosis by getting rid of CO2. • Arrhythmia, cardiac arrest • Loss of consciousness, coma, death.	• Hypoventilation (depressed respiration) → ↑PCO2 to compensate alkalosis. • Respiratory arrest • Confusion, coma, death

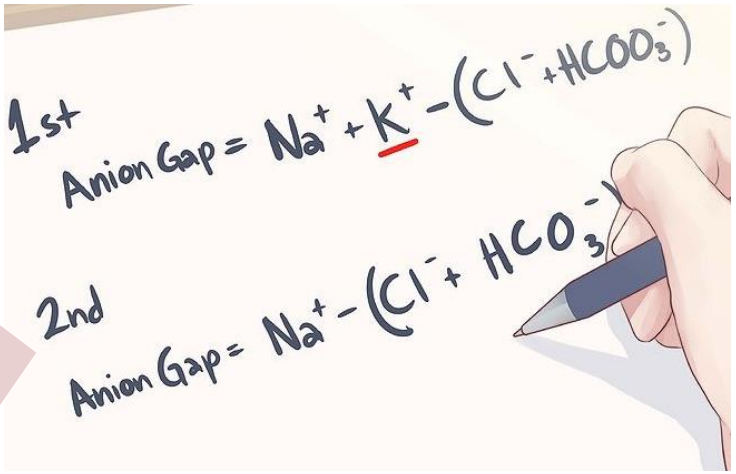
Anion gap

- It is the difference between the sum of:

Na^+ and K^+ (cations) and the sum of Cl^- and HCO_3^- (anions)

Importance:

Helps in assessing acid-base problems



2nd: calculating K+ is not that important so we excluded it, because it's found in a really small amount, even if its level changes it doesn't make any difference

Low anion gap: <3 mEq/L (alkalosis)

Normal anion gap: 3-11 mEq/L

High anion gap: >11 mEq/L (acidosis)

Only to recap ☺:

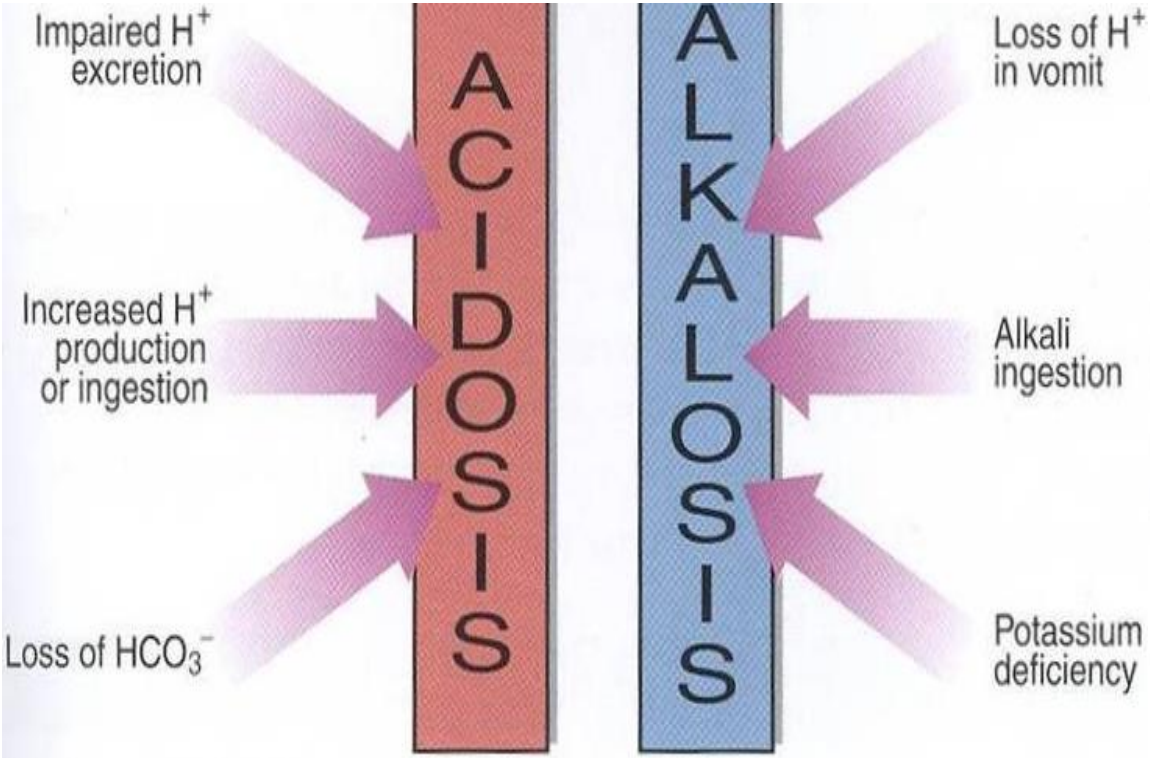


Fig. 3 **Reasons for metabolic acidosis and alkalosis.**

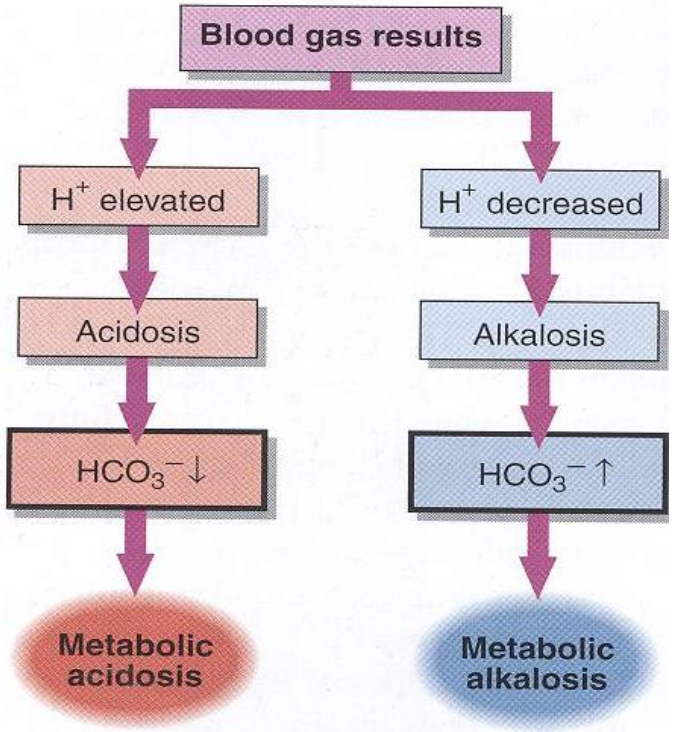
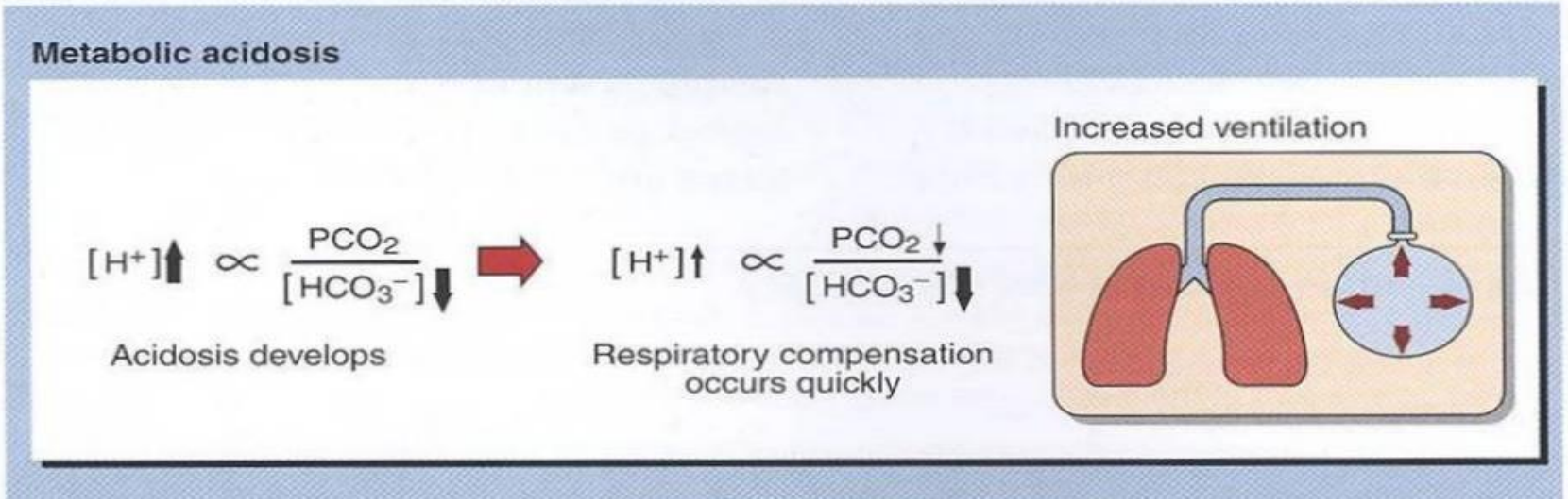
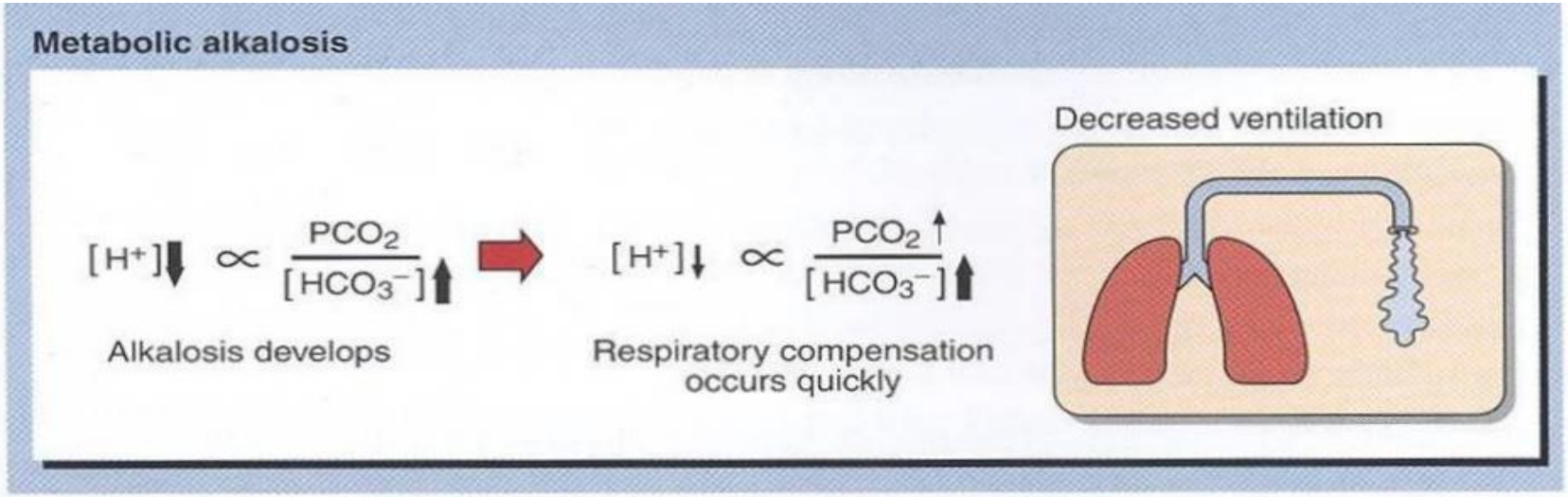


Fig. 1 **Recognizing primary metabolic acid–base disorders by inspecting the HCO_3^- concentration.**

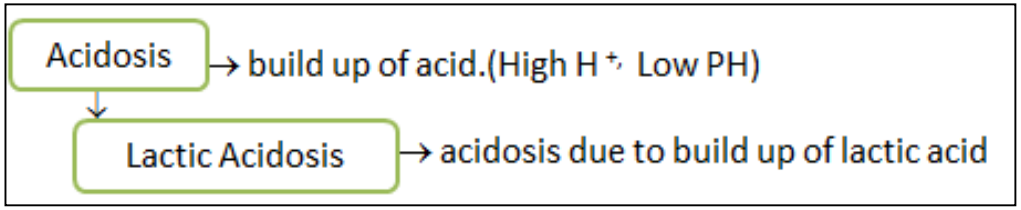
PH = HCO3 metabolic part
PCO2 respiratory part
Also, PH= - log (H ions)

Different ways in different systems to maintain normal PH:





Lactic Acidosis



Definition..?

Elevated conc. of plasma lactate is called lactic acidosis. It's a type of metabolic acidosis

Increasing Lactic acid →decreases Oxygen in tissue

Causes..?

1. Failure of circulatory system (hypoxia)
2. Disorders of carbohydrate metabolism

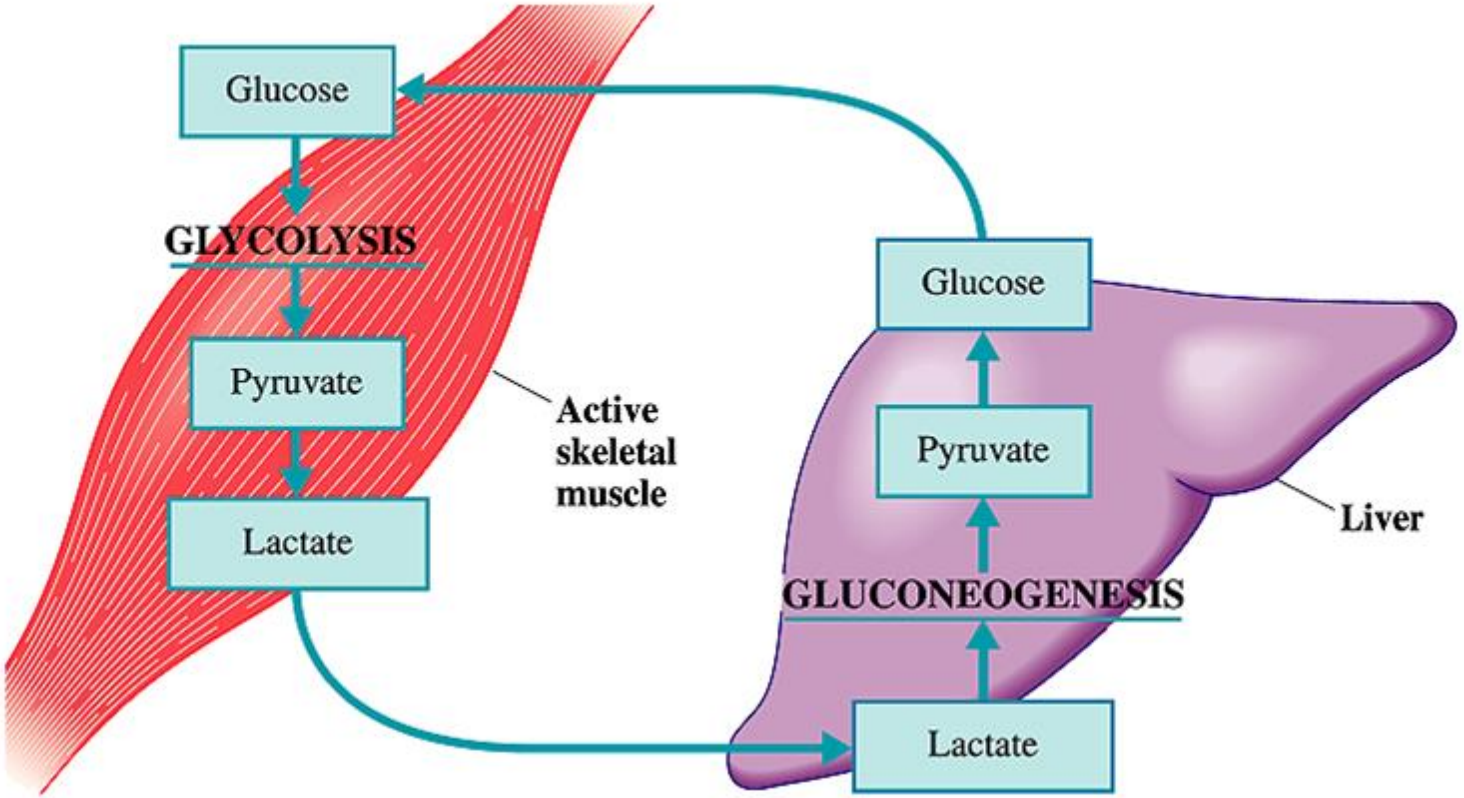
Metabolism of lactic acid..?

During vigorous exercise

- Lactate is metabolized in liver (60%) * and kidney (30%) to glucose(Cori cycle). See next slide.
- Some lactate is metabolized to CO2 and water (Krebs cycle).

* Lactate is mainly metabolized in liver

Cori Cycle



Lactate dehydrogenase

Pyruvate + NADH + H^+ ⟶ Lactate + NAD^+

Mechanisms involved in lactic acidosis

Lactic acidosis can occur due to:

1. Excessive tissue lactate production.
2. Impaired hepatic metabolism of lactate. It will not be converted to our friend glucose.

Types of lactic acidosis:

1. Type A (Most common)
2. Type B

Type A

Due to HYPOXIA in tissues (most common).

Hypoxia→impaired oxidative phosphorylation→ ↓ATP synthesis.

To survive, the cells switch to anaerobic glycolysis for ATP synthesis→Lactate as the final product.

The amount of oxygen required to recover from oxygen deficiency is called oxygen debt.

Due to inadequate supply of oxygen to tissues in:

- Myocardial infarction.
- Pulmonary embolism.
- Uncontrolled hemorrhage.
- Tissue hypoperfusion (shock, cardiac arrest, acute heart failure, etc.).
- Anaerobic muscular exercise.

Type B

NOT due to hypoxia

Due to

- Disorders in carbohydrate metabolism.

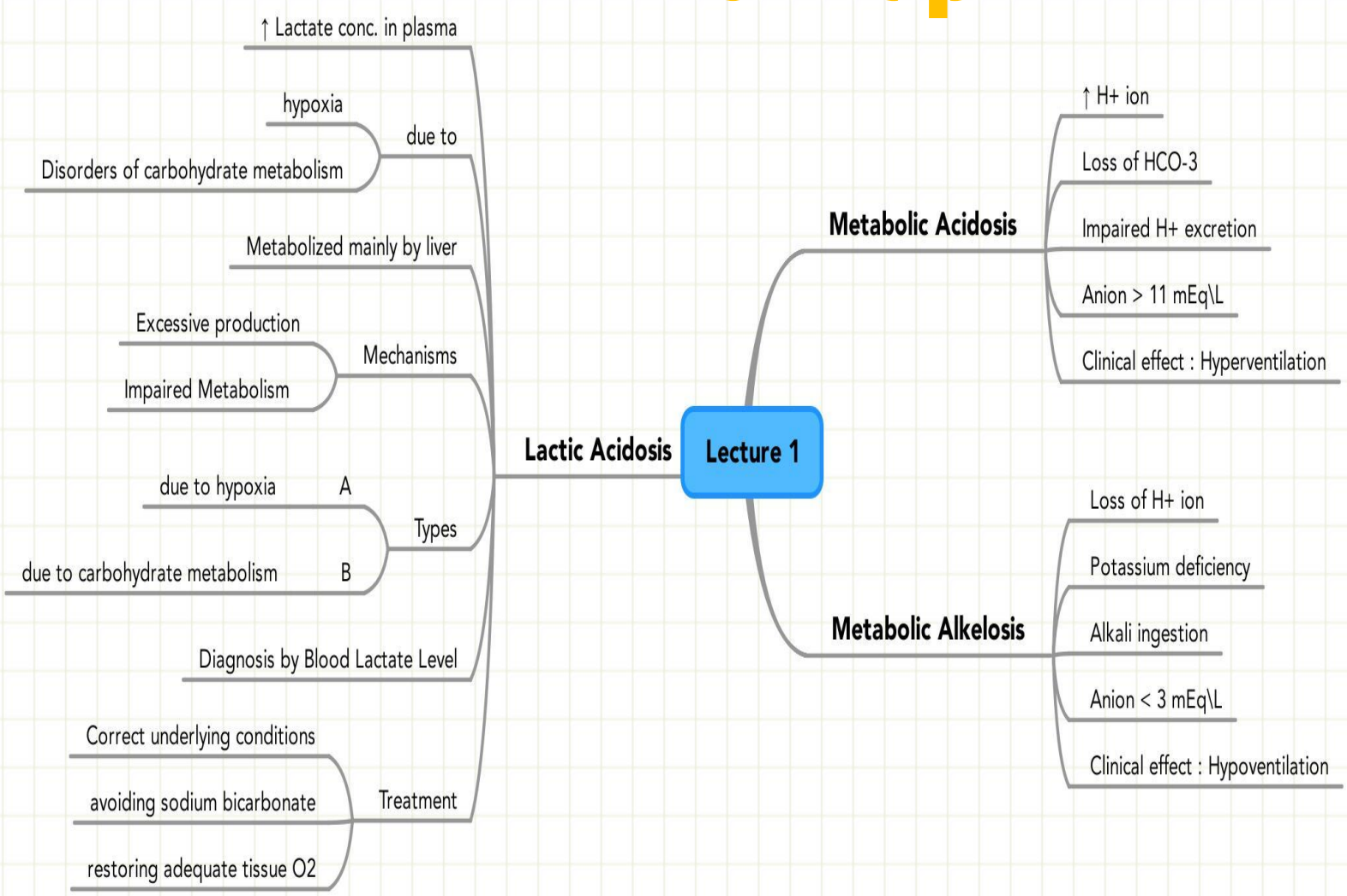
-Congenital lactic acidosis is due to deficiency of pyruvate dehydrogenase enzyme.

- Chronic hepatic disease accompanied by shock or bleeding.
- Liver failure.
- Drug intoxication.

Diagnosis and treatment

- **Diagnosis done by measuring blood lactate levels:**
  - ❖Hyperlactemia: 2 – 5 mmols/L
  - ❖Severe lactic acidosis: > 5 mmols/L
- **Treatment:**
  - ❖Correcting the underlying conditions
  - ❖Restoring adequate tissue oxygen
  - ❖Avoiding sodium bicarbonate

Mind map



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MCQs:

Now let's check your understanding☺

- **1- A FEMALE WAS PRESENTED WITH A CASE OF IMPARIED RENAL FUNCTION, WHCH OF THE FOLLOWING IS A COMLICATION ?**
- A- METABOLIC ACIDOSIS
- B- METABOLIC ALKALOSIS
- C- DIABETES

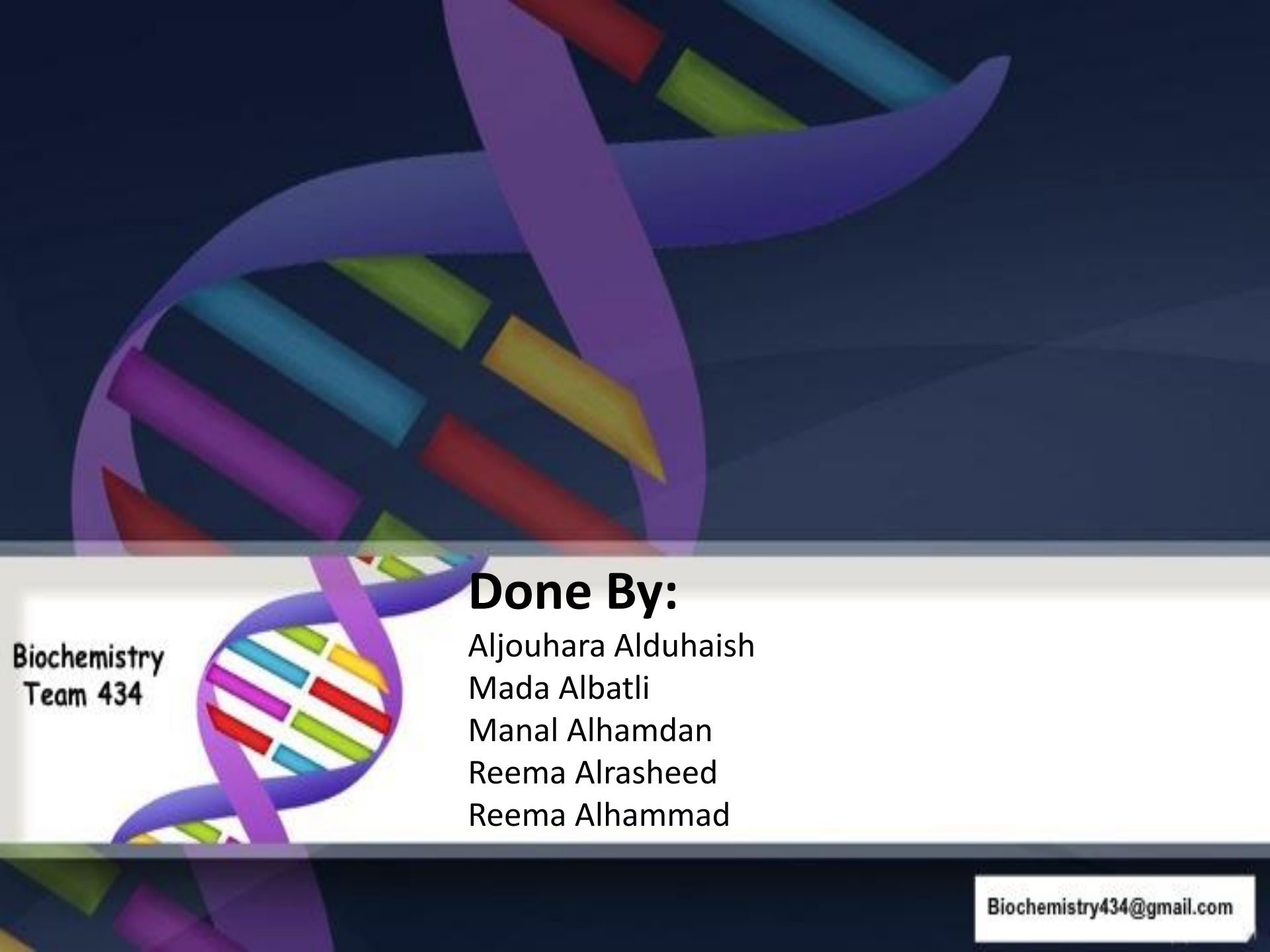
- **2- WHICH OF THE FOLLOWING IS RELATED TO HYPOXIA?**
- A- TYPE A LACTIC ACIDOSIS
- B- TYPE B LACTIC ACIDOSIS
- C- TYPE C LACTIC ACIDOSIS

- **3- WHICH OF THE FOLLOWING IS A MECHANISM IN DIAGONSING LACTIC ACIDOSIS?**
- A- MEASURING LACTATE IN URINE
- B- MEASURING LACTATE IN BLOOD
- C- MEASURING LACTATE IN CSF

- **4- TYPE B LACTIC ACIDOSIS IS A COMPLICATION OF?**
- A- DISORDERS IN PROTEIN METABOLISM
- B- DISORDERS IN GLUCOSE METABOLISM
- C- DISORDERS IN CARBOHYDRATE METABOLISM

- **5- WHICH OF THE FOLLOWING IS A MECHANISM IN TREATING LACTIC ACIDOSIS?**
- A- TREATING THE UNDERLAYING CAUSE.
- B- ISOLATION OF THE PATIENT.
- C- PERSCRIBE ANTIBIOTICS.

1- A.2- A .3- B .4- C .5- A



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