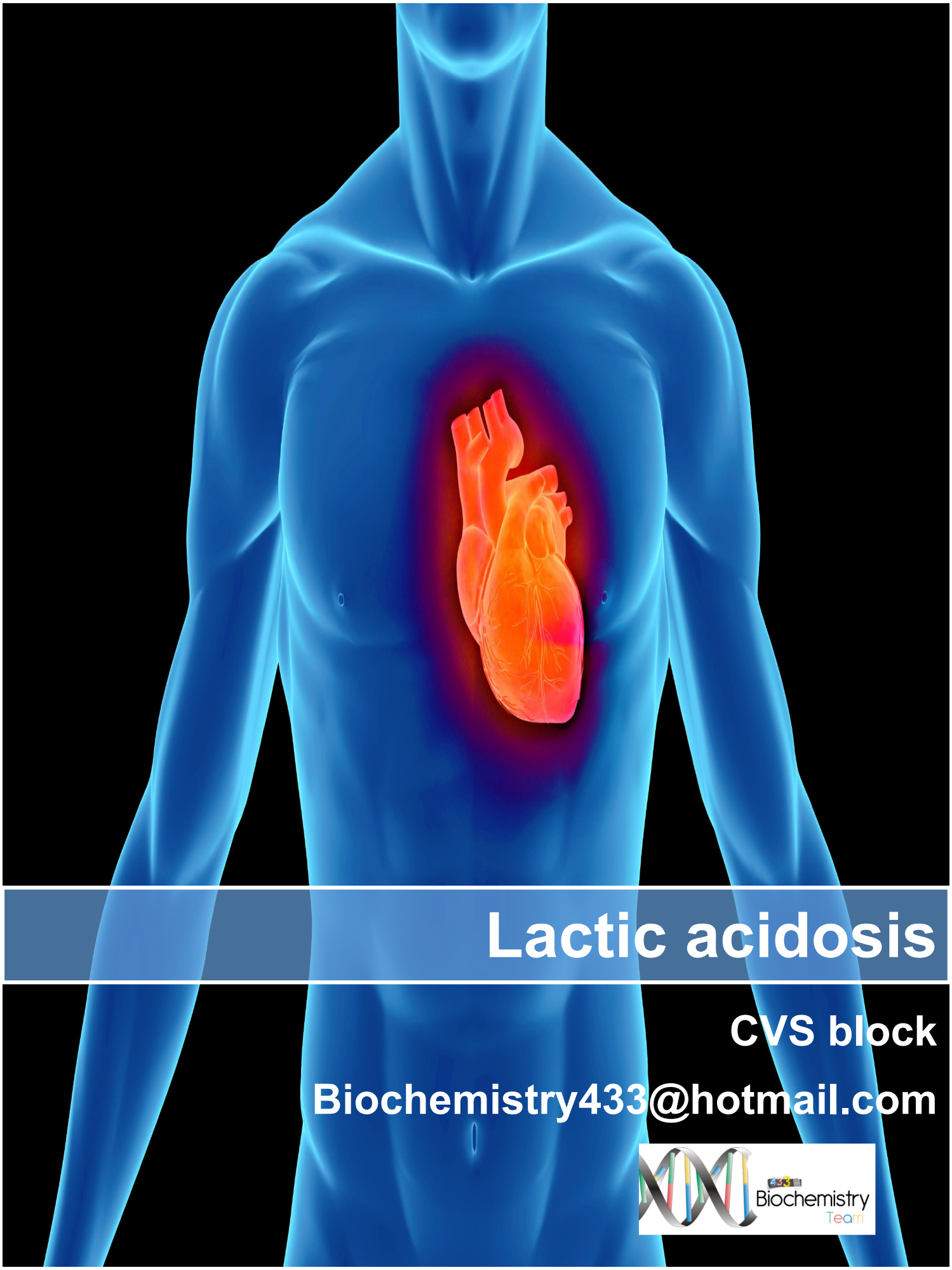


Lactic acidosis

CVS block

Biochemistry433@hotmail.com

Biochemistry Team

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

abbreviations:

- Conc. : concentration [CONCENTRATION].
- ECF : Extra Cellular Fluid.
- HCO3- : bicarbonate.

Definitions:

- anions: a negatively charged ion.
- cations: a positively charged ion.

Metabolic acid-base disorders

Are due to changes in bicarbonate conc. In the ECF → caused by high conc. or loss Of H^+ ions

	Metabolic alkalosis	Metabolic acidosis
	• Decreased H^+ • Elevated HCO_3^-	• Elevated H^+ • Decreased HCO_3^-
Causes	•Loss of H^+ in gastric fluid due to vomiting (the stomach is acidic). • Alkali (sodium bicarbonate) ingestion. • Potassium deficiency as a result of diuretic therapy (ex. Hypertension patients are given Diuretic drugs).	•Impaired H^+ excretion. •Increased H^+ production or ingestion of drugs metabolized to acids. •Loss of HCO_3^-
Occurs in		•Renal disease •Diabetic ketoacidosis •Lactic acidosis •Chronic diarrhea •Poisoning •Renal tubular acidosis
Clinical effects	•Hypoventilation (depressed respiration) → Increases PCO_2 to compensate alkalosis. •Respiratory arrest •Confusion, coma, death	•Hyperventilation (stimulated respiration) (kasmaul's respiration)→ compensates acidosis by getting rid of CO_2. •Increased H^+ conc. stimulates respiratory response. •Arrhythmia, cardiac arrest •Loss of consciousness, coma, death

Anion Gap

- It is the difference between the sum of:
  - Na+ and K+ (cations) and
  - the sum of Cl – and HCO3– (anions)
- Helps in assessing acid-base problems
- Normal anion gap: 3-11 mEq/L
- High anion gap: >11 mEq/L (acidosis)
- Low anion gap: <3 mEq/L (alkalosis)

$$AG = [Na^+] - \{[CL^-] + [HCO_3^-]\}$$

Lactic acidosis

- Elevated conc. of plasma lactate.

- Occurs either due to:
  - ✓Failure of circulatory system (hypoxia) (type A).
  - ✓Disorders of carbohydrate metabolism (type B).

- body produces ~ 1500 mmoles per day.
- The lactate enters blood stream and is metabolized mainly by the liver (Cori cycle)(60%) and kidney (30%) to glucose.
- Some lactate is metabolized to CO2 and water (Krebs cycle).
- All tissues can produce lactate under anaerobic conditions but skeletal muscles produce high amounts during strong exercises.

- Pyruvate is converted to lactate by lactate dehydrogenase enzyme.

- Lactic acidosis can occur due to:
  - ✓Excessive tissue lactate production.
  - ✓Impaired hepatic metabolism of lactate.

lactic acidosis

Type A

•Due to hypoxia in tissues (most common), anaerobic exercise, and cardiovascular problems.
•Hypoxia causes impaired oxidative phosphorylation and decreased ATP synthesis
•To survive, the cells switch to anaerobic glycolysis for ATP synthesis
•This produces lactate as a final product
•The amount of oxygen required to recover from oxygen deficiency (hypoxia) is called oxygen debt
•**Causes of hypoxia:**
- ✓Myocardial infarction (caused by ischemia of the coronary artery leading to hypoxia that will eventually lead to anaerobic metabolism and production of lactate).
- ✓Pulmonary embolism
- ✓Uncontrolled hemorrhage
- ✓Tissue hypoperfusion (shock, cardiac arrest, acute heart failure, etc.)
- ✓Anaerobic muscular exercise

Type B

•Due to disorders in carbohydrate metabolism
Examples of type B:
✓Congenital lactic acidosis is due to deficiency of pyruvate dehydrogenase enzyme.
✓Chronic hepatic disease accompanied by shock or bleeding
✓Liver failure
✓Drug intoxication

Diagnosis

- measuring blood lactate levels

  Hyperlactemia: 2 – 5 mmols/L

  Severe lactic acidosis: > 5 mmols/L

Treatment

- Correcting the underlying conditions
- Restoring adequate tissue oxygen
- Avoid sodium bicarbonate, because it's a weak alkaloid and it will also affect the phosphofructokinase enzyme that increases the production of lactic acid.
- For type A we should use O_2 ventilation for treatment to compensate for the hypoxia.

Two things that are important in the diagnosis:

- How high the level of lactate in the blood.
- How fast it is going.

Summary

1. Changes in HCO_3 conc in ECF cause acid-Base Disorders.
2. ↓ of HCO_3 in ECF Due To ↑H^+ → clinical effect: Hyperventilation
3. ↑ of HCO_3 in ECF Due to ↓H^+ and ingestion of sodium Bicarbonate → clinical effect: Hypoventilation.
4. Anion gap Normal [3-11 mEq/L]
   - acidosis >11
   - Alkalosis < 3
5. we can see acidosis in many cases EX: Chronic Diarrhea.
6. ↑ lactate conc in plasma called Lactic acidosis Due to
   - carbohydrate Metabolism
   - Hypoxia
   - Disorders
7. Body tissue produce 1500 mmoles of lactate Per Day.
8. lactate Metabolism → 60% liver, 30% Kidney, Some Metabolized to CO_2 & H_2O in Kreb cycle
9. Hyperlactemia 2-5 mmoles/L. Sever lactic acidosis > 5 mmole/L
10. we can Treat lactic acidosis by Restoring adequate O_2.

QUIZ YOURSELF!!

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

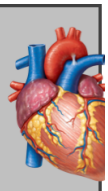
3- WHICH OF THE FOLLOWING IS A MECHANISM IN DIAGONSING LACTIC ACIDOSIS?
A- MEASURING LACTATE IN URINE
B- MEASURING LACTATE IN BLOOD
C- MEASURING LACTATE IN CSF

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.

ANS: 1- A 2- A 3- B 4- C 5- A

Good luck



From our team members:

Sara alDokhayel	**Ahmed Al-Hussien**
Maha AlRajhi	Meshal Al-Ohali
Lamees alMezaini	Abdulrahman alharbi
Batoul Al-Suhaibani	Faisl Alghamdi
Jowaher alabdulkarim	Ziyad Alajlan
Maram alaqil	Ahmed Alqhtani
Amjad AlBatili	Mojahed Otef