DEPARTMENT OF BIOCHEMISTRY

CLINICAL ENZYMOLOGY

LECTURE 1

BY

DR.DALYA SHAKIR OBIADA

Clinical Enzymology

❖ INTRODUCTION

- Enzymes are protein catalysts that increase the rate or velocity of physiologic reactions in our body
- In general, most enzymes are present in cells at much higher concentrations than in plasma.
- Measurement of their levels in plasma indicates whether their tissue of origin is damaged leading to the release of intracellular components into the blood
- clinical enzymology refers to measurement of enzyme activity for the diagnosis and treatment of diseases.

Types Of Plasma/serum Enzymes

A. Enzymes that have definite physiological functions in the circulation such as

- Lipoprotein lipase
- Proenzymes of blood coagulation

B. Enzymes that reflect organ pathophysiology

- Normally present in extremely low concentrations in plasma as compared with their high concentrations in various tissues.
- In case of tissue damage, they are released in greater amounts causing higher plasma levels which have diagnostic and sometimes prognostic significance.
- Include:
  - Enzymes present in exocrine secretions, which diffuse passively into the circulation e.g. amylase and lipase in pancreatic disorders.
  - Intracellular enzymes: enzymes used to detect pathological disorders of the various organs of the body e.g. myocardial infarction and hepatitis.

Sources of plasma/Serum enzymes

1. **Increase in the rate of enzyme synthesis** e.g. bilirubin increases the rate of synthesis of alkaline phosphatase in obstructive liver diseases.
2. **Obstruction of normal pathway** e.g. obstruction of bile ducts increases alkaline phosphatase.
3. **Increased permeability** of cell membrane as in tissue hypoxia.
4. **Cell damage** with the release of its content of enzymes into the blood e.g. myocardial infarction and viral hepatitis.

Medical importance of Plasma/Serum enzymes

- Measurement of non-functional plasma enzymes for:

1. **Diagnosis of diseases**: diseases of different organs cause elevation of different plasma enzymes.

2. **Prognosis of the disease**: follow up the effect of treatment by measuring plasma enzymes before and after treatment.

The diagnostic precision of plasma enzyme analysis

Estimation of more than one enzyme:

- Many enzymes are widely distributed, but their relative concentrations may vary in different tissues.
- For example, although both ALT and AST are available in the liver, the concentration of AST (GOT) is much greater than that of ALT (GPT) in heart muscle

Factors Affecting Results Of Plasma Enzyme Assays

❖ Analytical factors:

1. substrate concentration
2. product concentration
3. enzyme concentration
4. reaction temperature
5. reaction pH
6. presence of activators or inhibitors

Factors Affecting Results of Plasma/Serum Enzyme Assays

❖ Non-disease factors

1. **Age:** Plasma AST activity is moderately higher during the neonatal period than in adults. Plasma ALP activity of bony origin is higher in children than in adults.
2. **Sex** : Plasma GGT activity is higher in men than in women. Plasma CK activity is also higher in males.
3. **Race/ethnicity:** Plasma CK activity is higher in black people than in white people.
4. **Physiological conditions:** Plasma ALP activity rises during the last trimester of pregnancy, Why?
5. .**Several enzymes,** such as AST and CK, rise moderately in plasma during and immediately after labour or strenuous exercise.

Measurement of enzyme activity

- **Enzyme activity is expressed in International unit (IU/L)**
- It corresponds to the amount of enzymes that catalyzes the conversion of one micromole of substrate(μmol) to product per minute per liter.

1.Enzymes For Diagnosis Liver diseases

1. **Markers of hepatocellular damage.:**

- Enzymes which are normally present inside the hepatocytes released into the blood when there is a hepatocellular damage
  - **Alanine aminotransferase (ALT)**
  - **Aspartate aminotransferase (AST)**

2. **Markers of cholestasis :**

- Enzymes which are primary membrane bound (plasma membrane or side of hepatocytes)
  - **Alkaline phosphatase,**
  - **Gamma glutamyl transferase (GGT)**
  - **5-nucleotidase**

1. Markers of hepatocellular damage

❑ Aminotransferases/Transaminases

- The aminotransferases are used as part of the **biochemical liver profile**.
- **Aminotransferases** are **sensitive indicators of liver cell injury** and are most helpful in recognizing acute hepatocellular diseases such as hepatitis
- These enzymes are released into the blood in greater amounts when there is damage to the liver cell membrane resulting in increased permeability.

❑ **Types of plasma Aminotransferases**

– **Aspartate transaminase (AST)** enzyme, it is also called serum glutamic oxalacetic transaminase(SGOT)

– **Alanine transaminase (ALT)** enzyme, it is also called serum glutamic pyruvic transaminase (SGPT)

❑ Aminotransferases/Transaminases

- **AST and ALT enzymes** are more important in assessing and monitoring the degree of liver cell inflammation and necrosis.
- **In acute viral hepatitis** there is a 100-1000 times increase in both ALT and AST but ALT level is increased more than that of AST
- According to AST/ALT ratio, we can estimate the extent of the liver damage.
- Elevated **plasma ALT** are considered to be relatively **specific for liver disease than AST** as AST may be elevated in other forms of tissue damage, such as myocardial infarction, muscle necrosis and renal disorders.
- Aminotransferases levels **> 1000 IU/L** occur almost exclusively in disorders associated with extensive hepatocellular injury

Clinical Significance

- **Normal values of AST:**
  - Male: <35 U/L Female: <31 U/L
- **Normal values of ALT:**
  - Male: <45 U/ Female: <34 U/L