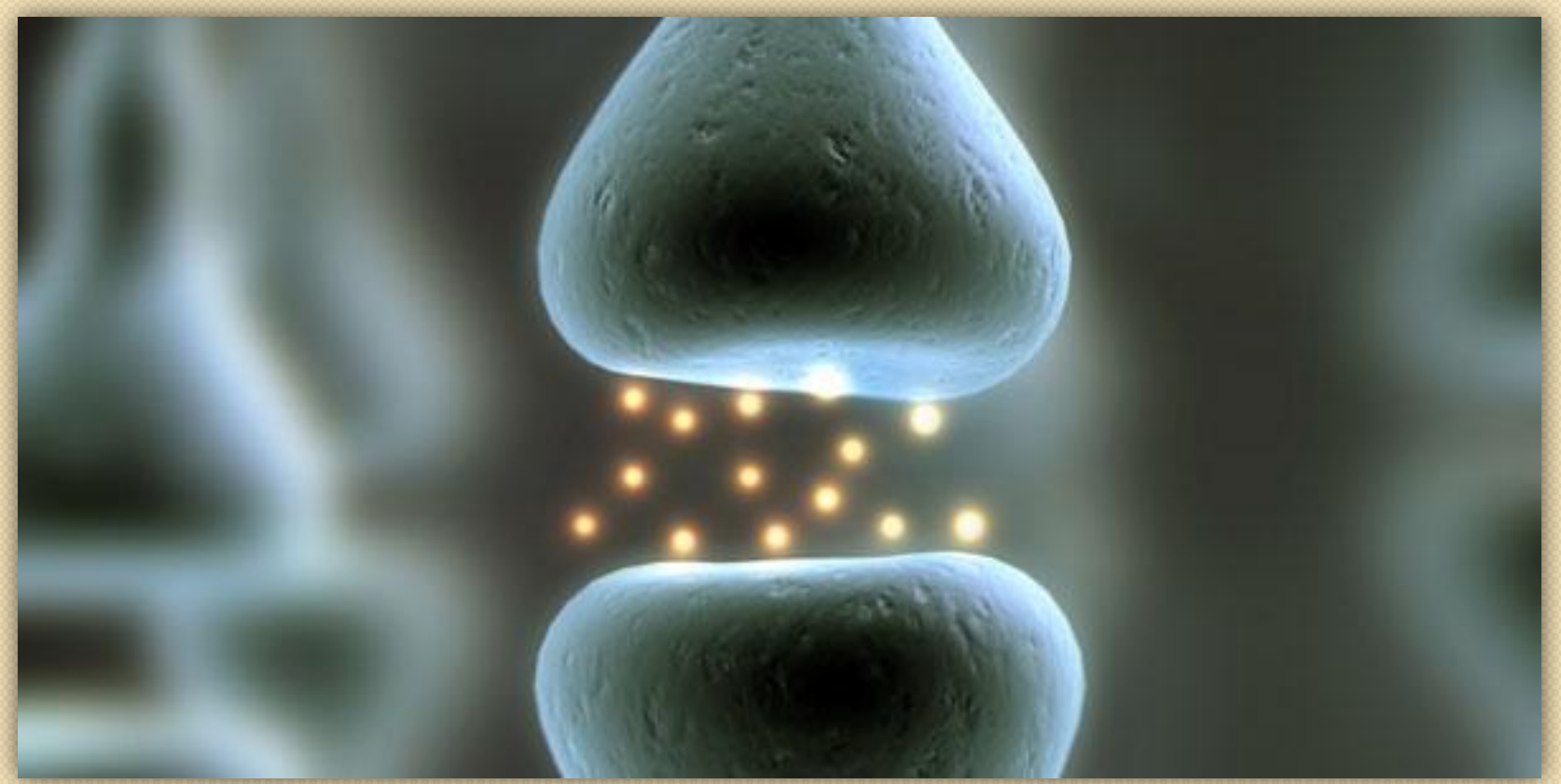
BIOCHEMISTRY TEAM ..

Biochemical markers in disease diagnosis



biochemical markers

- What is a biomarker?
- Enzymatic diagnosis and prognosis of a disease
- Enzymes as markers of disease: Amylase, ALT, AST
- Plasma proteins as markers of disease: Albumin
- Tumor markers: α-fetoprotein, PSA

what is a biomarker?

biomarker

- **A biological molecule found in blood, other body fluids, or tissues that indicates a normal or abnormal process such as a disease or a condition**
- **A biomarker is measured to follow up a disease or treatment**

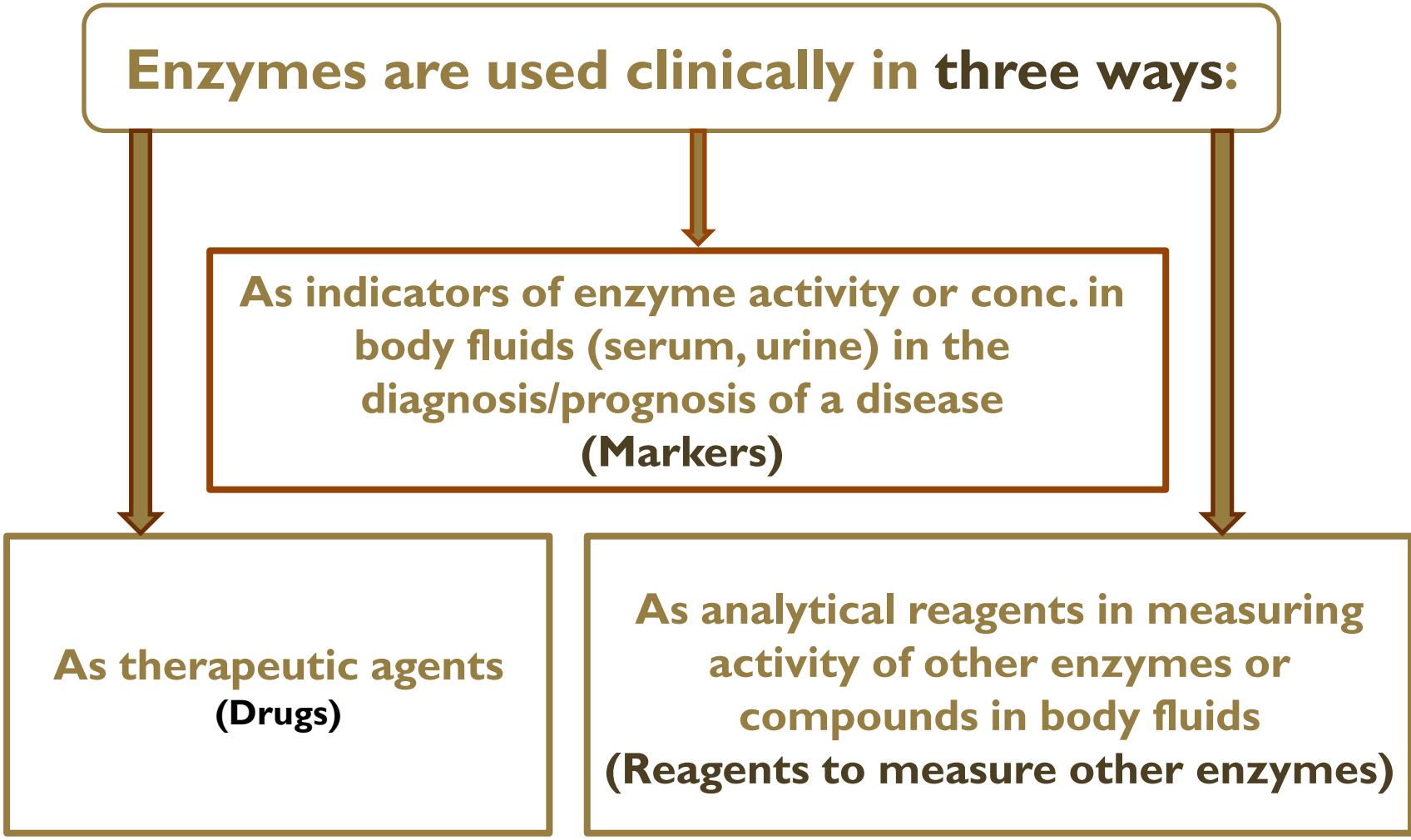
*Follow up means: Looking after the patient status before & after the treatment.

diagnosis and prognosis ?

- **Diagnosis**
- **Identification of a disease from its signs and symptoms.**

- **Prognosis:**
- **The future outcome of a disease.**

- enzymatic diagnosis & prognosis of disease



❖ Most common body fluids: serum and plasma

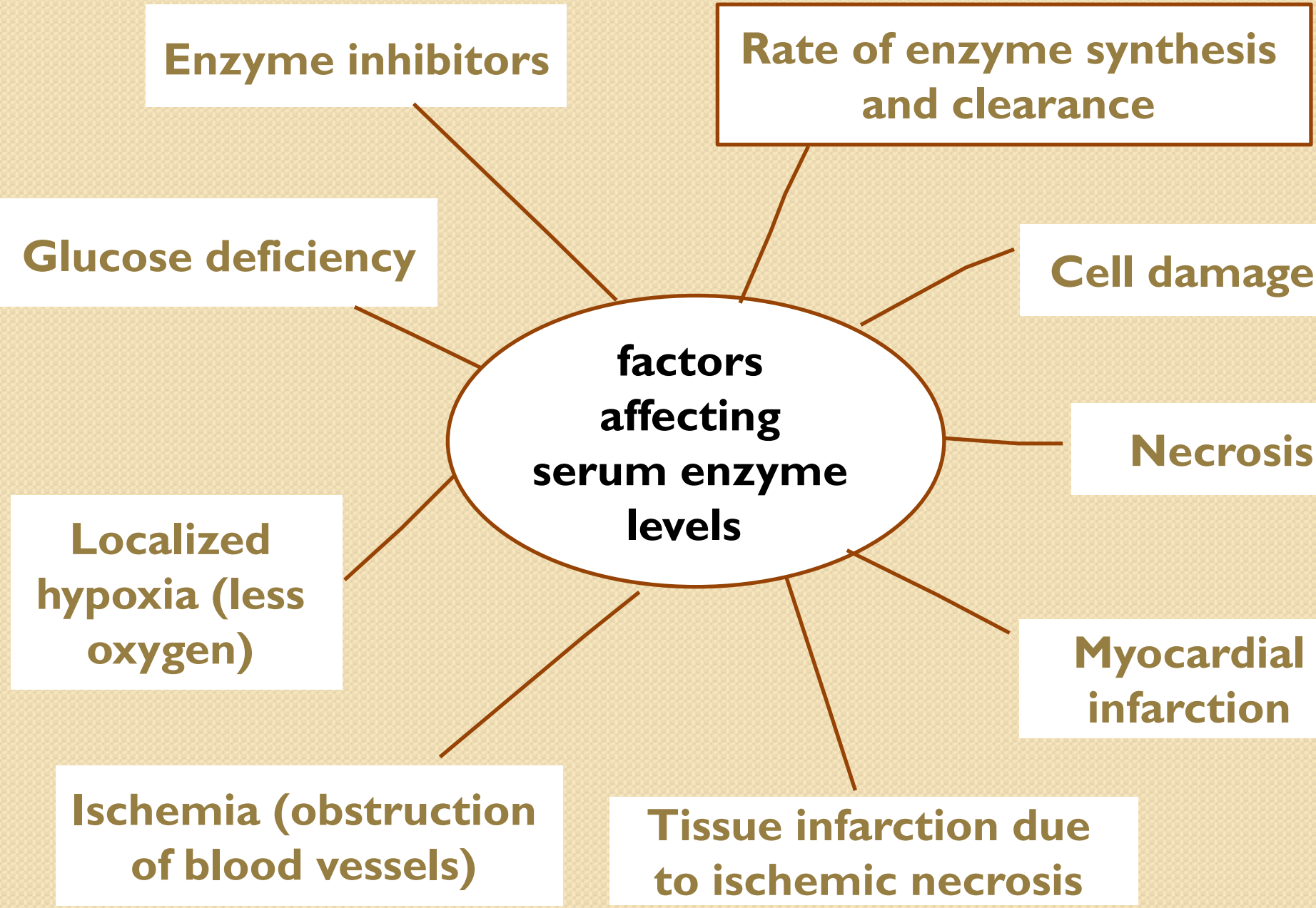
- **Enzymes are:**

Plasma-specific enzymes	• **Normally present in plasma** • **Perform their functions in blood** • **High level of activity in plasma than in tissue cells** • **Examples: blood clotting enzymes (thrombin), cholinesterase, etc.**

Non-plasma-specific enzymes	• Present inside the cell(tissues)
	• Conc. is lower in plasma
	• Released into the body fluids in high conc. due to:
	  • cell damage
	  • defective cell membrane

- Intracellular enzymes are present only in their cells of origin.
- Some are secretory enzymes that are secreted by salivary glands, gastric mucosa and pancreas.
- In disease, plasma levels of secretory enzymes increase when their cells are damaged.
- The diagnosis of organ disease is done by measurement of enzymes of that tissue.

*if you have an organ disease , you have to check if there is any problem with the enzymes


Enzyme inhibitors
Rate of enzyme synthesis and clearance
Glucose deficiency
Cell damage
factors affecting serum enzyme levels
Necrosis
Localized hypoxia (less oxygen)
Myocardial infarction
Ischemia (obstruction of blood vessels)
Tissue infarction due to ischemic necrosis

• Enzymatic markers ..

Amylase

- Elevated serum amylase level is a diagnostic indicator of acute pancreatitis
  - Amylase level greater than 10 times the upper limit indicates acute pancreatitis
- The test has low specificity because elevated serum amylase level is also present in other diseases
- Amylase appears in the serum within 2-12 hours after abdominal pain
- Free amylase (unbound form) is rapidly cleared by the kidneys

Alanine aminotransferase (ALT)

- Mostly present in liver
- Small amounts in heart
- More specific for liver disease than AST
- Major diagnosis: liver disease

Aspartate aminotransferase (AST)

- Widely distributed in heart, liver, skeletal muscle, kidney
- Small amounts in erythrocytes
- High serum activity of AST found in:
  - Liver disease, heart disease, skeletal muscle disease, hemolysis
- Major diagnosis: myocardial infarction, liver and muscle diseases

Amylase in acute pancreatitis

Acute pancreatitis is the inflammation of pancreas caused by:

- Obstruction of the pancreatic duct.
- Gallstones (main cause of acute pancreas).
- Alcohol abuse.

- **Abnormal release of pancreatic enzymes and their premature activation**
- **The main pancreatic enzyme is trypsinogen**
- **Trypsinogen is activated to trypsin**
- **Trypsin converts other enzymes to active form such as kallikrein, phospholipase A_2, elastase, etc.**
- **Effects of abnormal release of enzymes: autodigestion of pancreas, vasodilation, respiratory failure, etc**

Enzymatic diagnosis

Measurement of pancreatic enzymes:

- Amylase
- Lipase
- Trypsinogen

High ALT and AST in liver diseases ..

- Alcohol abuse
- Medication
- Chronic hepatitis B and C
- Steatosis and steatohepatitis
- Autoimmune hepatitis
- Wilson's disease
- a1–antitrypsin deficiency
- Malignancy
- Poisons and infectious agents

Serum enzymes used in the assessment of liver function:

Markers used in hepatocellular necrosis	Markers used in cholestasis
• Alanine aminotransferases • Aspartate aminotransferases	• Alkaline phosphatase • 5'-nucleotidase- • γ-glutamyl transferase

plasma proteins as markers (albumin) ..

- **Functions**

1- Oncotic pressure (pressure exerted by plasma proteins that pulls water into the circulatory system) = **(remember the osmotic)**

- 80% of plasma oncotic pressure is maintained by albumin.
- Fluid distribution in and outside cell, plasma volume.

2- Buffering – some buffering function.

3- Transport – lipid-soluble molecules, hormones, calcium, drugs, etc. in Blood.

Plasma Proteins As Markers ..

Hypoalbuminemia		Hyperalbuminemia
Causes	Effects	causes
Decreased albumin synthesis – failure of synthesis due to genetic reasons and malnutrition Increased volume of albumin distribution – in liver disease Increased losses of albumin – increased catabolism in infections, nephrotic syndrome, hemorrhage, severe burns, etc.	Edema due to low oncotic pressure -Albumin level drops in liver disease causing low oncotic pressure (to hold fluids within cells) -Fluid moves into the interstitial spaces causing edema Reduced transport of -Substances in plasma. -Drugs (free form – more active).	Dehydration is a major cause of hyperalbuminemia

TUMOR MARKERS..

- A molecule secreted by a tumor that is measured for diagnosis and management of a tumor.

α-fetoprotein	Prostate specific antigen (PSA)
• In newborn babies a-fetoprotein levels are very low. • High conc. are observed in: ➢ hepatocellular carcinomas (hepatoma). ➢ testicular carcinomas. ➢ GI tract carcinomas. • However, high serum levels are also found in benign (non-cancerous) conditions e.g. **hepatitis** • High conc. are not always suggestive of tumor.	• A serine protease enzyme also called kallikrein III, seminin. • Produced by prostate gland. • Liquefies ejaculate. • High serum PSA levels are observed in prostate cancer. • Less specific in diagnosis. *High serum levels are also observed in benign prostatic hypertrophy (enlarged prostate gland)

Student notes:

1) Albumin: Is a plasma protein marker.
2) (PSA) : Prostate Specific Antigen.
3) Enzymes are found in plasma normally.
4) Every tissue have a specific marker.
5) Enzyme inhibitor ↑ = more enzyme ↓ & (Vice versa).
6) Diagnosis based on: - Markers. - Clinical activites.
7) Markers goals are: - Follow up. - diagnose a disease.
8) Low Albumin = Edema.
9) α-fetoprotein is not specific.
10) When patient have a prostate cancer = the patient have a high amount of PSA.
11) When the marker is less specific, its need a combination with other marker. (That will help us to reach to a specific tissue)

Biochemistry team wish you good luck ..

***If you take life casually, it will take you casually.**