Clinical Importance of the Enzymes

The concentration of certain enzymes which are not usually present or are present in almost insignificant amounts in the plasma rises several times under certain pathological conditions. Such enzymes do not usually have to perform any function in the plasma of the blood, and are therefore, known **non-functional enzymes.** of blood these enzyme are ultinately excreted or destroyed These is unequal distribution of certain enzymes in different tissues depending upon the type of function these have to perform, damage of a particular tissue results in increase of a particular enzyme in the blood. Thus, the rise of a particular non-functional in blood my give an idea regarding the site of damage or dysfunction of the tissue, and thus help in the clinical diagnosis of a particular disease.

Some of the clinically useful findings are as follows :

1. **Serum Alkaline phosphatase (ALP) :** Serum alkaline phosphatase is largely derived in adults from liver but in growing children additional quantities are also derived from bone tissue. Some amount of alkaline phosphatase is also derived in both the cases from intestine.

Under clinical conditions, the extra large amount of ALP might either be derived from the bones due to diseases resulting into increased osteoblastic activity, or from the liver due to cholestasis. ALP production in liver is increased and ALP may be regurgitated into the blood from bile. The normal and clinical values of the serum ALP are as follows :

Subjects	**Serum Alkaline Phosphatase activitiy (K.A. units/100ml)**
Normal Adults	3-13
Normal Infants & children	12-30
Bone Disesase	
-Osteomalacia	40-80
-Rickets	100-150
-Pagets Disease	100-200
-Primary hyperparthyroidism with bone diseases	70-100
-Multiple myeloma	20-30
Liver Diseases	
-Obstructive Jaundice	30-100
-Hepatitis	20-40
-Tumours	30-100

2. Serum Acid Phosphatase (ACP) : Although acid phosphatase is found to be present in prostate gland, liver, red blood cells, platelets and also in the bones, but under the clinical conditions source of rise in the serum ACP levels is the prostate gland. Prostatic ACP is inhibited by L-tartrate (tartrate labile). The levels of serum ACP, both tartrate labile and total, in normal and clinical conditions are as follows.

Subjects	**Total ACP**	**Tartrate Labile ACP (K.A. Units/100ml)**
Normal	1-3	0-0.8
Prostatic carcinoma	10-50	5-20
After Rectal examination	5-20	3-8
Acute retention of urine	6-18	3-17
Goucher's disease	7-14	0.5-1.2

Pagest's disease	8-20	0.5-2.0

3. 5'-Nucleotidase (NTP) : The serum levels of nucleotidases are increased in various liver diseases with cholestasis. The normal and clinical serum 5' nucleotidase levels are as follows:

Subjects	**NTP Levels (I.U./Liter)**
Normal	2-17
Liver Diseases	
-Obstructive jaundice	100-150
-Hepatitis	20-40
-Tumours	100-150

4. Serum Glutamic-Oxaloacetic Transaminase (SGOT) or Aspartate Transaminase (AST) : Glutamic oxaloacetic transaminase is maximally present in the heart followed by liver, skeleal muscle and kidney. SGOT levels are found to be raised in myocardial infarction and also in liver diseases, however, the level is found to be normal in angina pectoris. The SGOT rise occurs with a peak value after 24 hours of infarction. The raised values remain up to about five days. The normal and clinical levels of SGOT are as follows:

Subjects	**SGOT activity (I.U./Liter)**
Normal	4 - 20
Myocardial infarction	15 to 100 times of normal
Viral hepatitis	15 to 100 times of normal
Toxic liver necrosis	15 to 100 times of normal
Circulatory failure with shock	15 to 100 times of normal
Cirrhosis of liver	2 to 10 times of normal
Cholestatic jaundice	2 to 10 times of normal

Skeletal Muscle disease	2 to 10 times of normal
Haemolytic anaemia	2 to 10 times of normal

5. Serum Glutamic Pyruvic Transaminase (SGPT) or Alanine Transaminase (ALT) : SGPT is found in highest concentrations in the liver, followed by the kidney. Heart and skeletal muscle are very poor in the GPT. SGPT levels are found to be raised in liver diseases such as infective hepatitis, toxic hepatitis, and circulatory failure with shock. Very small rise occurs in SGPT levels in the cirrhosis of liver, cholestatic jaundice and skeletal muscle damage. The normal and clinical values of SGPT are as follows :

Subjects	**SGPT (I.U./Litre)**
Normal	4-15
Viral hepatitis, Toxic liver and Circulatory failure	15 to 100 times of normal
Cirrhosis of liver, Cholestatic jaundice, skeletal muscle disease	2 to 10 times of normal

6. Serum Lactic dehydrogenase (LD or LDH) : Lactic dehydrogenases widely distributed in high concentration in the heart, skeletal muscle, liver, kidney, brain and erythrocytes. The enzyme exists in its five isoenzymic forms i.e. LD_1, LD_2, LD_3, LD_4, and LD_5.

LD_1 is found in the heart, muscles, erythrocytes and kidney. LD_5 occurs predominantly in the liver. The heart isoenzyme has two important characteristics (i) it is heart stable relatively and (ii) it is, active against the substrate of alpha since alpha hydroxybutyrate dehydrogenase (HBD) activity is possessed only by heart LD, it is used in some of the laboratories in place of LD in the diagnosis of the disorders of heart. The normal and clinical levels of LD and HBD are as follows :

Subjects	I.D. (I.U./L)	HBD (I.U./L)
Normal	50-170	40-100
Myocardial infarction Pernicious anaemia, Viral hepatitis	5-10 times	5 to 10 times raised
	5-10 times	5 to 10 times raised
Skeletal muscle disease Acute hermolysis		-
Cerebral infarction Renal diseases	2 to 4 times	-

7. Serum Isocitric dehydrogenase (ICD or ICDH) : Isocitric dehydrogenase is widely distributed in liver, skeletal muscles, heart and kidney. ICD level is found to be raised in liver cell damage.

Subjects	ICD activity (I.U./L)
Normal	0.9 to 4.0
Acute Infective hepatitis	20 - 60

ICD activity has been found to be normal in liver cirrhosis and obstructive jaundice.

8. Creatine Phosphokinase (CPK) or Creatine kinase (CK) : Creatine Phosphokinase is found to be rich in heart and skeletal muscles. The activity of this enzyme is increased in myocardial infarction and muscular dystrophy. The normal serum CPK activity varies from 4-60 IU per litere. After myocardial infarction, serum CPK is found to be increased after 4 to 6 hours and reaches peak value within 24 to 30 hours and normal levels return within 72 hours. CPK activity is a more sensitive indicator in the early stages of myocardial ischaemia. Serum CPK level remain unaffected in heart failure or coronary

insufficiency. Serum CPK should be estimated in fresh blood. Serum CPK levels are also found to rise in muscular dystrophy, muscle injury and severe muscular exertion.

9. Serum Amylase : Large amounts of pancreatic and salivary amylase may find its entry in blood stream during obstruction of the ducts or their inflammation or during disruption of the cells. Very high values of amylase are found in serum in pancreatitis.

Subjects	**Serum amylase (Somogyi units/100ml)**
Normal	60 to 180
Acute Pancreatitis	600 to 3000
Renal failure	600 to 1500
Mumps	500 to 600

10. Serum Lipases : Increase in serum lipase again reflects existence of pancreatic disease.

Subjects	**Serum Lipase activity (Cherry -Crandall units/100ml**
Normal	1 to 1.5
Acute Pancreatitis	6 to 12
Chronic Pancreatitis	4 to 8
Intestinal obstruction	6 to 12

11. Gamma - Glutamyl transpeptidase : This enzyme is also known as gamma glutamyl transferase. Highest activity of this enzyme is found in kidney followed by liver, lungs, pancreas and prostate. Some activity is also found in thyroid, spleen and intestinal mucosa. Normal heart contains very little of this enzyme. The normal value of this enzyme in the serum is in the range 10-47-I.U./L in the males and 7-30 I.U./L in the females. This enzyme

increases in acute myocardial infarction. Peak activity in serum is found between 7th to 11th day and persists for nearly one month. Hence, this enzyme could be used as marker in latter stages of myocardial infarction. This enzyme is also increased in hepatobiliary disorders, pancreatic diseases and epileptic patients.

12. Serum Cholinesterase : True cholinesterase is found in the nerve tissues and red blood cells. Pseudocholinesterases are found in liver, heart muscles and intestines and in the serum. Normal value of serum pseudocholinesterase is 2-5 I.U./ml by de le huerge et al method. In acute myocardial infarction, serum pseudocholinesterase levels rise in almost 90 percent of cases within 12 hrs. It is a useful index of myocardial cellular necrosis. Serum cholinesterase level is found to be increased in nephrotic syndrome.

13. Leucine aminopeptidase : The normal levels of LAP are found to be 15-56 mIU in serum. It is highly increased in liver cell carinoma and hepatoma. Slight increase in LAP occurs in cirrhosis of liver and viral hepatitis.

14. **Beta-Glucuronidase :** This enzyme is widely distributed in liver, spleen, breasts, adrenals, endometrium and leucocytes. Normal serum beta glucuronidase activity is found in the rage 210-550 m IU in females and 90-400 m IU in females. High serum beta glucuronidase activity is found in cancer of breasts, cervix, head of pancreas. Increase in serum and urinary beta-glucuronidase is found in cancer of urinary bladder. Increased activity of beta glucuronidase in vaginal fluid is found in malignancy of genital tract of females.