Enzymes are produced intracellularly, and released into the plasma and body fluids, where their activities can be measured by their abilities to accelerate the particular chemical reactions they catalyze. But different serum enzymes are raised when different tissues are damaged. So serum enzyme determination can be used both to detect cellular damage and to suggest its location in situ. Some of the biochemical markers such as alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, gamma glutamyl transferase, nucleotidase, ceruloplasmin, alpha fetoprotein, amylase, lipase, creatine phosphokinase and lactate dehydrogenase are mentioned to evaluate diseases of liver, pancreas, skeletal muscle, bone, etc. Such enzyme test may assist the physician in diagnosis and treatment.

**Keywords**: Liver Function tests, Serum Amylase, Lipase, CPK and LDH.

**Diagnostic serum enzyme**

Enzymes are very helpful in the diagnosis of cardiac, hepatic, pancreatic, muscular, skeletal and malignant disorders. Serum for all enzyme tests should be free from haemolysis and should be separated from the red cells within four hours of blood collection. The majority of serum enzymes remains stable for at least five days at 4°C.

**Transaminases**

In human body tissue the predominant transaminases are glutamate – oxalacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT), both of which play an important role in the metabolism of amino acid. GOT catalyses the transfer of the amino group from the amino acid glutamate to the keto acid oxalacetate finally to pyruvate. These enzymes are referred to as aspartate aminotransferase (AST) and alanine aminotransferase (ALT). Large amount of GOT are present in cardiac muscle compared with other tissues of the body such as liver, skeletal muscle and kidney¹. However elevated mitochondrial AST is seen in extensive tissue necrosis during myocardial infarction and also in chronic liver diseases like liver tissue degeneration and necrosis². But lesser amounts are found in brain, pancreas and lung. Although GPT is plentiful in the liver and occurs only in the small amount in the other tissues. In cellular injury to the cardiac muscle, GOT activity increases. In liver cell injury considerable increase in the serum level of both enzymes takes place. Transaminases in myocardial infarction SGOT is raised in 95% of the cases: maximum enzyme level rises during 6-8 hrs after infarction and reaches to peak level after 24 hrs, and returns to normal within 6 days. The SGPT usually remains normal, but may show on elevation slight in degrees compared with that of the SGOT if the infarct is normal. One of the studies has shown that coffee and caffeine consumption reduce the risk of elevated serum ALT activity in excessive alcohol consumption, viral
hepatitis, iron overload, overweight and impaired glucose metabolism.

**Transaminases in liver disease**
Serum transaminase determination is useful in the detection of acute and chronic hepatocellular disease. The differentiation of the jaundice of infective hepatitis from that of extra hepatic biliary obstruction and the detection of hepatic metastasis. Transaminase determination provides a most sensitive indicator of liver cell damage and may reveal liver disease at a time when conventional liver function tests are normal.

**Viral Hepatitis**
In viral hepatitis level of both SGOT and SGPT increases markedly at the onset of disease. High values may also be encountered in the pre icteric phase. Enzyme level falls rapidly within a few days and in uncomplicated cases normal level are reached within 2 – 5 weeks from the onset of jaundice. Failure of viral hepatitis to resolve is associated with persistently raised transaminase activity.

**Infectious Mononucleosis**
SGOT and SGPT are almost invariably raised in infectious mononucleosis even in the absence of jaundice or any clinical evidence of hepatic involvement. Raised levels are found in the early course of the illness.

**Toxic Hepatitis**
The serum transaminases are elevated by a wide variety of the agents causing toxic damage to the liver. Raised values are observed in carbon tetrachloride poisoning, salicylate intoxication and chlorpromazine sensitivity. Mild elevation may also follow the administration of anovulatory compounds used as contraceptive agents, coumarian compounds and phenindione used in anticoagulant therapy of thrombolic disorders. Raised levels return to normal with the removal of the toxic agent.

**Obstructive Jaundice**
Both SGOT and SGPT are almost always raised in extra hepatic obstructive jaundice. The Transaminase level remain high until obstruction is relieved and returns to normal within a week.

**Hepatic Cirrhosis**
Majority of the cases of cirrhosis show increased level of SGOT and one half of the cases of increased SGPT level may fluctuate widely.

**Gamma Glutamyl Transferase (GGT)**
GGT is a microsomal enzyme present in hepatocytes and biliary epithelial cells, renal tubules, pancreas and intestine. In acute viral hepatitis the level of GGT will reach the peak promptly. In other conditions like uncomplicated diabetes mellitus, acute pancreatitis, myocardial infarction, anorexia nervosa, Gullian Barre syndrome, hyperthyroidism, obesity and distrophica myotonica, there are elevated levels of GGT.

**Hepatic Metastasis**
In metastatic carcinoma of the liver SGOT is raised, whenever SGPT elevation is less frequent.

**CPK in Muscle disease**
Serum CPK activity is raised in all varieties of muscular dystrophy; the marked incidence and the highest values being noticed in the Duchonne type dystrophy. Levels are high in infancy and childhood also. Increased serum CPK values are also found in the myopathy which may accompany chronic alcoholism and with the muscular symptoms which may follow acute alcoholic intoxication.

**Creatine Phosphokinase (CPK) in myocardial infarction**
Majority of the patient with myocardial infarction show raised serum CPK value. Elevation commences some 4-5 hours following infarction, reaches a peak by 24 to 36 hrs, but returns to normal by the third day. The sensitivity and early elevation of serum CPK following myocardial infarction may assist in the prompt selection of those patient with chest pain requiring the services of an intensive care unit. CPK values are not altered in liver diseases. Therefore hepatic congestion and liver disorder, which may accompany cardiac disease are not a source of diagnostic confusion. Pericarditis also shows normal serum CPK activity, but raised values are found in myocarditis.

**CPK in cerebrovascular and other diseases.**
The serum of patient with acute cerebrovascular disease may show raised CPK activity, which is
maximal three days after the acute episode and return
to normal by the fourteenth day. Slight elevation of
CPK values are frequent in hypothyroidism and are
occasionally found in peripheral arterial embolism.

**Lactate Dehydrogenase (LDH)**
This enzyme catalyses the reversible oxidation of
lactate to pyruvate and is important in anaerobic
glycolysis, the process in which the body obtains its
energy from carbohydrate breakdown. The enzyme is
abundant in renal, cardiac, Hepatic and muscular
tissues.

**LDH in myocardial infarction**
In myocardial infarction the incidence of LDH is
higher than that of SGOT and CPK. The major
advantage of LDH determination is that its elevation
is much more prolonged, and is thus of special value.
Initial blood samples cannot be obtained until some
days after the infarctive episode. LDH starts to rise 12
hours after infarction, touches peak within 48 hrs.
and stays elevated for another eleven days.

**LDH in non Cardiac disorders**
Raised LDH values are found in renal disease, liver
disease, disseminated malignancy and certain
hematological disorders. Renal infarction or trauma
may be accompanied by raised LDH and some of
cases of chronic hepatitis and nephritic syndrome may
show increased LDH activity.

**Hydrolysing Enzyme**
Hydrolytic reactions are catalyzed by many enzymes
including the digestive enzymes, amylase, lipase and
the phosphatase enzyme, 5'nucleotidase, amino
peptidase and cholinesterase. Determination of
amylase and lipase activity are used as aids to
diagnose pancreatic disease. Alkaline phosphatase is
useful in the study of disorders of bone and together
with 5'nucleotidease and leucine aminopeptidase is
used in the investigation of liver disease. Acid
phosphatase is valuable in the diagnosis of prostatic
malignancy. Cholinesterase determination is helpful
in the detection of organo phosphorus insecticide
toxicity.

**Lipase**
Lipase is an enzyme that hydrolyses triglycerides to
glycerol and free fatty acid is produced by the
pancreas, and appears in the serum. Raised serum
lipase values are found in acute pancreatitis and level
may reach 10 times the upper limit of the normal.
Serum lipase activity remains elevated longer than
does amylase and may thus permit confirmation of the
diagnosis of suspected acute pancreatitis when
amylase activity has returned to normal. Serum lipase
levels may be elevated following hormone stimulation
of the pancreas in subjects with carcinoma of the
pancreas or chronic pancreatitis.

**Amylase**
The starch splitting serum enzyme amylase is
principally derived from the pancreas and salivary
glands. In acute pancreatitis, the serum enzyme starts
to rise within a few hours and remains elevated for
three to four days. For amylase many commercial
assay’s are not yet traceable to the IFCC reference
measurement procedure. In other acute abdominal
conditions, e.g. perforated peptic ulcer, cholecystitis,
common bile duct and intestinal obstruction, raised
serum amylase values are also found, but the levels
are seldom as high as those found in acute
pancreatitis.

**The phosphatase**
Several enzymes in serum hydrolyse phosphate
monoesters. Two of these are relatively non specific
in their substrate requirements and are optimally
active at alkaline and acid pH and hence are known as
alkaline and acid phosphates respectively. A third
which hydrolyses nucleotide pentose 5 phosphates as
specific substrate is known as 5 nucleotidase.

**Alkaline phosphatase**
The phosphate is most active between pH values of 8
and 9. Normal range is different according to the use
of substrate. Alkaline phosphatase is formed in bone
intracellularly by osteoblast and is also present in
liver, kidney, intestine and placenta. Increased serum
level of alkaline phosphatase are found both in
skeletal and hepatic disorders.

**Alkaline phosphatase in bone disease**
Raised serum alkaline phosphatase is found in Paget
disease, Hyperparathyroidism, in healing fractures,
and in presence of osteoblastic carcinoma metastases.
Increased serum alkaline phosphate activity
accompanied by raised serum calcium suggests
hyperparathyroidism. Healing fracture may show very
slight alkaline phosphatase elevation.
Alkaline phosphate in Liver disorders

Determination of serum alkaline phosphatase is of great value in the differential diagnosis of jaundice.

Acid phosphatase

An enzyme that acts to liberate phosphate under acidic conditions and is made in the liver, spleen, bone marrow, and prostate gland. High serum levels of acid phosphatase may indicate infection, injury, or cancer of the prostate.

Alpha fetoprotein (AFP)

AFP is the major serum protein in the developing mammalian foetus produced at a high level by the foetal liver and visceral endoderm of the yolk sac and at low levels by foetal gut and kidney. AFP is required for female fertility during embryonic development by protecting the developing female brain from prenatal exposure to estrogen. The normal level of AFP is 0 – 7 IU/ml. A high value more than 500 IU/ml has been considered to be diagnostic of hepatocellular carcinoma in patient with cirrhosis.

Ceruloplasmin

Ceruloplasmin is synthesized in the liver and is an acute phase protein. It binds with the copper and serves as a major carrier for copper in the blood. The level is elevated in infections, rheumatoid arthritis, pregnancy, non-Wilson liver disease and obstructive jaundice. Decreased rate of synthesis of the ceruloplasmin is responsible for copper accumulation in liver because of copper transport defect in Golgi apparatus, since ATP 7B is affected, serum ceruloplasmin levels are increased in the chronic active liver disease but lowered in the Wilson’s disease. Hence it is a more reliable screening test to differentiate between chronic Liver Disease and Wilson’s disease.

5’Nucleotidase

5’nucleotidase is a protein produced by the liver and the test can be measured in the laboratory to know the activities in patient with obstructive jaundice, parenchymal liver disease, hepatic metastases and bone disease. Elevation of 5’nucleotidase is found in both acute infective hepatitis and in chronic hepatitis; however increased activity is higher in acute hepatitis as compared to that in chronic hepatitis.

Diagnostic Value of Serum Enzymes-A review on Laboratory Investigations.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>ENZYMES</th>
<th>METHOD</th>
<th>NORMAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SGOT</td>
<td>ENZYMATIC</td>
<td>5 – 50 U/L</td>
</tr>
<tr>
<td>2.</td>
<td>SGPT</td>
<td>ENZYMATIC</td>
<td>5 – 50 U/L</td>
</tr>
<tr>
<td>3.</td>
<td>GGT</td>
<td>ENZYMATIC</td>
<td>5-35 U/ML</td>
</tr>
<tr>
<td>4.</td>
<td>CPK</td>
<td>ENZYMATIC</td>
<td>24– 105 U/L</td>
</tr>
<tr>
<td>5.</td>
<td>LDH</td>
<td>ENZYMATIC</td>
<td>230 – 400 U/L</td>
</tr>
<tr>
<td>6.</td>
<td>LIPASE</td>
<td>ENZYMATIC</td>
<td>0 – 190 U/L</td>
</tr>
<tr>
<td>7.</td>
<td>AMYLASE</td>
<td>ENZYMATIC</td>
<td>60 – 160 SU</td>
</tr>
<tr>
<td>8.</td>
<td>ALKALINE PHOSPHATASE</td>
<td>ENZYMATIC</td>
<td>70 – 230 U/L</td>
</tr>
<tr>
<td>9.</td>
<td>ACID PHOSPHATASE</td>
<td>KING ARMSTRONG</td>
<td>1.5 – 3.5 KA</td>
</tr>
<tr>
<td>10.</td>
<td>ALPHA FETO PROTEIN</td>
<td>AUTOMATIC SYSTEM</td>
<td>0 – 7 IU/ML</td>
</tr>
<tr>
<td>11.</td>
<td>CERUOPLASMIN</td>
<td>MANUAL</td>
<td>24– 36 mg/dl</td>
</tr>
<tr>
<td>12.</td>
<td>5’ NUCLEOTIDASE</td>
<td>MANUAL</td>
<td>2-17 IU/L</td>
</tr>
</tbody>
</table>

Reference values of serum enzymes.

REFERENCES


