Aminotransferases : Alanine and Aspartate aminotransferase

Aminotransferases are basically transaminase that catalyze the transfer of the ?-amino group(alpha-amino group) of aspartate amino acid (known as aspartate aminotransferase) or alanine amino acid (aka alanine aminotransferase) to the ?-keto group(alpha-keto group) of ketoglutarate with vitamin B6 being a cofactor.

This reaction results in the formation of new amino acid and a new keto acid.

In this reaction, there is no net deamination (loss of amino group) since the alpha-ketoacid becomes aminated as the alpha-amino acid becomes deaminated.

They are called transaminases because they aminate a compound with an amino group that has been transferred from an amino acid.

Transamination reactions, which interconvert pairs of ?-amino acids and ?-keto acids, are readily reversible, and they function in the biosynthesis of amino acid.

The transamination process takes place via a “ping-pong” mechanism. The coenzyme pyridoxal phosphate (PLP) is present at the catalytic site of all these aminotransferases. and because of its role here we shall have a simple look into the vitamin B6.

Aminotransferases are enzymes which are mainly found in the liver. These enzymes can also be found in other tissues for example muscles but at fairly small levels. They are a component of normal metabolic processes in the liver.

Alanine aminotransferase was previously referred to as serum glutamic-pyruvic

transaminase or SGPT whereas Aspartate aminotransferase was known as serum glutamic-oxaloacetic transaminase (SGOT).

GPT-Alanine aminotransferase

Alanine transaminase catalyzes the interconversion of alanine and alpha-ketoglutarate to glutamate and pyruvate.

GOT-Aspartate aminotransferase

Aspartate transaminase (AST) acts as a catalyst in the interconversion of aspartate and ?-ketoglutarate to oxaloacetate and glutamate.

L-Aspartate + ?-ketoglutarate ? oxaloacetate + L-glutamate

What is the role of vitamin B6?

Vitamin B6 consists of three closely related compounds ie;

1. Pyridoxine (pyridozole),
2. Pyridoxamine and,
3. Pyridoxal.

All these in their active form is phosphorylated and are interconvertible biologically.

Vitamin B6 is active in its phosphorylated coenzyme form (pyridoxol phosphate) and functions in the formation and breakdown of amino acids,

What is the role of GPT and GOT in medicine?

In medicine, the major application of serum alanine aminotransferase and alanine aminotransferase levels is the detection and differential etiologic diagnosis of (liver) hepatic disease.

1.Liver function tests measurement

SGPT and SGOT are part of the liver function panel. You can have a look at the liver function tests in this article here.

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    - Liver function tests and interpretation.

1. Increased activity in liver disease ie in viral hepatitis, alcohol toxicity hepatitis, liver cirrhosis , liver cancer.
2. Gall bladder and biliary obstruction,
3. Myocardial diseases eg Myocardial Infarction,
4. Skeletal muscle diseases ie muscular dystrophy and prolonged physical exercise.

They are used to determine the liver damage due to toxic effects of chemicals such as carbon tetrachloride (CCL4), chloroform and dry cleaning agents together with some chemical toxins…

These enzymes have decreased activity in cases of vitamin B6 deficiency because of the reason that we have mentioned above.

These tests are used to determine the severity of heart attacks and monitor recovery together with cardiac biomarkers that you can find here.

- Cardiac Biomarkers.

Location of aminotransferases

To this point you may have asked yourself where ate these enzymes specifically located or in which tissues are they found?

Alanine aminotransferases are found mainly in the liver and in a low concentration in kidneys, heart, pancreas, spleen, and RBCs. This enzyme is ***cytosolic.***

Aspartate aminotransferases are found in the liver, heart, and muscles and red blood cells. It is both ***cytosolic and mitochondrial.***

There are 2 types if AST isoenzymes

1. **cAST**, cytosolic isoenzyme derived from RBCs and heart.
2. **mAST**, mitochondrial isoenzyme mainly present in the liver.

These enzymes are elevated in;

- liver diseases ie viral hepatitis, alcohol hepatitis and ischaemic hepatitis.
- Thyroid disorders,
- Celiac disease.
- Muscle disorders,
- Heart disorders such as myocardial infarction.

What Are Normal and Elevated (High) Levels of Liver Enzymes?

Normal alanine aminotransferase levels range from about 7-56 units/liter, and

Normal aspartate aminotransferase levels are between 10-40units/liter.

Interpretation of Aminotransferases results

Elevated levels of both aspartate aminotransferase and alanine aminotransferase signify the level of liver injury in a patient.

Acute elevation or short term elevations indicate a sudden liver injury whereas chronic or long-term elevation suggests an ongoing injury to the liver.

Besides duration being an important feature, the level of abnormal elevation of the aminotransferases is also important. For example in some diseases, there could be a mild elevation which is consistent with a mild liver injury.

The AST: ALT ratio **(De Ritis ratio)** more than 2 can be used to determine the alcohol-induced liver disease.

A patient who has elevated levels of Aspartate aminotransferase and normal alanine aminotransferase levels shows that the patient has a normal functioning liver but has an injury to other tissues or even hemolysis.

These liver enzyme levels can be very high up to 10 to 20 times the normal values. This severe elevation suggests more significant liver damage.

Elevated AST and ALT indicate acute viral hepatitis, non-alcoholic hepatitis or toxic hepatitis.

Higher serum AST levels that ALT are seen in chronic hepatitis and liver cirrhosis.

Modest elevation with AST>ALT is seen in intrahepatic or posthepatic diseases and cholestatic lesions.

AST activity is usually consistently increased in myocardial infarction.

Passive liver congestion is associated with elevated ALT.

When do you order liver function tests?

You order these tests when you realize a patient has the following features that you may need to investigate further.

- Abdominal pain or swelling,
- Nausea and vomiting,
- Jaundice,
- Fatigue,
- Dark-colored urine,
- Drinker – the alcoholic patient.
- Patient taking some medicines ie hepatotoxic drugs,
- Non-alcoholic liver disease,
- Blockage of bile duct either due to cancer or obstruction,
- Intense exercise,
- Snake bites because there is a tendency of increased hemolysis,
- Industrial poisoning.