



Clinical Chemistry

Liver Function Tests <



Introduction

The liver is one of the largest and most vital organs in the human body, performing essential metabolic, detoxifying, and regulatory functions.

Key Functions:

- Metabolism: Carbohydrates, proteins, and fats.
- Detoxification: Processes drugs and toxins.
- Protein Synthesis: Albumin, clotting factors.
- Bile Production: Aids in digestion and absorption of fats.

Liver Health and Disease

The liver is resilient, but it can suffer from various diseases and conditions:

Hepatitis: Inflammation of the liver, often caused by viral infections (hepatitis A, B, C), alcohol, or autoimmune reactions.

Cirrhosis: Scarring of liver tissue from chronic injury, often due to long-term alcohol use, hepatitis, or fatty liver disease.

Fatty Liver Disease: Excess fat builds up in the liver due to obesity, poor diet, alcohol use, or metabolic syndrome.

Liver Cancer: Primary liver cancers, like hepatocellular carcinoma, often arise from chronic liver disease or cirrhosis.

Drug-Induced Liver Injury: Certain medications and toxins can damage liver cells, leading to inflammation or even acute liver failure.

Liver Function Test (LFT) profile

Integrity of liver cells

Excretory function

Synthetic function



Liver enzymes
AST, ALT, GGT, ALP

Bilirubin, ALP

Proteins
TP, Alb, A/G ratio

Determination of liver enzymes

- Small amounts of intracellular enzymes are present in the blood as a result of normal cell turnover.
- When damage to cells occurs, increased amounts of enzymes will be released and their concentrations in the blood will rise.
- However, such increases are not always due to tissue damage. Other possible causes include:
 1. increased cell turnover
 2. cellular proliferation (E.g. neoplasia)
 3. increased enzyme synthesis (enzymes induction)
 4. obstruction to secretion

ALT

- Alanine Aminotransferase (ALT) is an enzyme primarily found in the liver, with smaller amounts in the kidneys, heart, and muscles. ALT plays a key role in converting proteins into energy for liver cells, and it's a common component of Liver Function Tests (LFTs) used to assess liver health. Elevated levels of ALT in the bloodstream often signal liver damage or disease.
- Also Known As: Serum glutamate-pyruvate transaminase (SGPT)
- Normal Range: Typically between 7 to 55 units per liter (U/L), though this can vary slightly between labs.

Role of ALT in the Body

- ALT is involved in the amino acid and protein metabolism in liver cells, specifically by transferring an amino group from alanine to alpha-ketoglutarate to form pyruvate.
- This enzyme's activity is mostly confined to the liver, which is why it's an effective marker for liver health.

Clinical Significance

Rise in the ALT level happens in:

1. Viral or autoimmune hepatitis.
2. Cirrhosis.
3. Lack of blood flow to the liver (liver ischemia).
4. Death of liver tissue (liver necrosis).
5. Liver tumor.
6. Use of drugs that are poisonous to the liver.
7. Biliary duct problems.

❖ When elevated ALT levels are found in the blood, the possible underlying causes can be further narrowed down by measuring other enzymes. For example, elevated ALT levels due to liver-cell damage can be distinguished from biliary duct problems by measuring **alkaline phosphatase**.

Interpreting ALT Levels

- **Mild Elevation:** Generally less than 2-3 times the upper limit (often due to mild liver issues, fatty liver).
- **Moderate Elevation:** 3-5 times the upper limit, potentially indicating conditions like hepatitis.
- **High Elevation:** More than 10 times the upper limit, often associated with acute hepatitis, liver failure, or drug-induced liver injury.

AST

- Aspartate Aminotransferase (AST) is an enzyme found in various tissues throughout the body, particularly in the liver, heart, muscles, kidneys, and brain. Although it is present in multiple organs, AST is commonly used as a marker in liver function tests (LFTs) to evaluate liver health.
- Also Known As: Serum glutamic-oxaloacetic transaminase (SGOT)
- Normal Range: Typically 8 to 48 units per liter (U/L), though values can vary by laboratory and patient demographics.

Role of AST in the Body

- **Protein Metabolism:** AST helps in the transamination process, which is crucial for protein metabolism, by converting aspartate and alpha-ketoglutarate into oxaloacetate and glutamate.
- **Location in the Body:** Although most AST is in the liver, significant amounts are also present in the heart and skeletal muscles, making it a useful marker for liver and some heart and muscle conditions.

Clinical Significance

AST is raised in acute liver damage. It is also present in red blood cells and cardiac muscle, skeletal muscle and may be elevated due to damage to those sources as well.

When liver cells are damaged, AST and ALT levels rise especially early in the disease.

In hepatitis, transaminase levels rise several days before jaundice begins.

The enzyme levels are especially useful in assessing subtle and early changes in biliary obstruction and active cirrhosis

Interpreting AST Levels

- **Mild Elevation:** Typically less than 2-3 times the upper limit of normal, often related to mild liver conditions or muscle injury.
- **Moderate Elevation:** Between 3-10 times the upper limit, which may indicate acute or chronic liver disease.
- **High Elevation:** More than 10 times the upper limit, which is commonly associated with acute liver damage, such as from hepatitis or significant heart or muscle injury.

ALT / AST ratio

AST is assessed along ALT in monitoring liver damage. These two values normally exist in an approximately 1:1 ratio.

➤ As a rough guide:

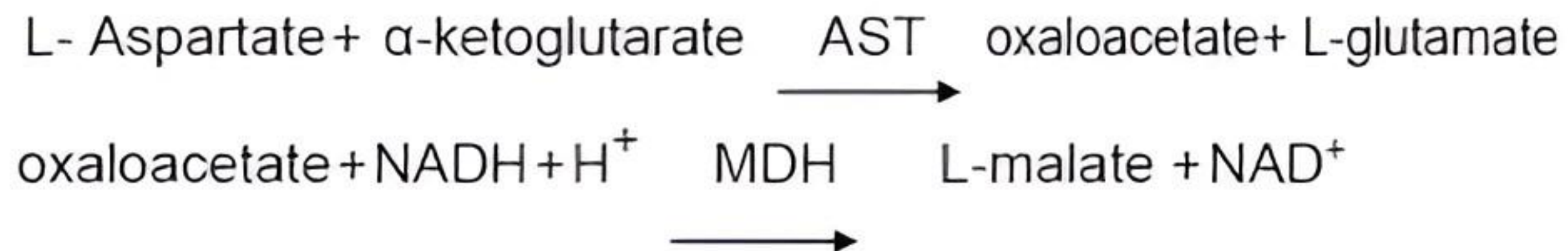
A) $AST > ALT$ in:

- alcoholic hepatitis and cirrhosis,
- metastatic cancer of the liver
- non-biliary cirrhosis,

B) while $ALT > AST$ in:

- viral and drug hepatitis,
- chronic hepatitis C
- hepatic obstruction.

Principle



Aspartate Aminotransferase is measured by monitoring the concentration of oxaloacetate hydrazone formed with 2,4-dinitrophenyl-hydrazine.

Wavelength: Hg 546 nm (530 - 550 nm)

Cuvette: 1 cm light path

Incubation Temperature: 37°C

Procedure

Measurement Against Reagent Blank

	BLANK	SAMPLE
Sample	-	0.1 ml
Buffer R1	0.5 ml	0.5 ml
D.W	0.1 ml	-

Mix, incubate for exactly 30 min. at 37°C

2,4-dinitrophenylhydrazine (R2)	0.5 ml	0.5 ml
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Mix, allow to stand for exactly 20 min. at 20 to 25°C

Sodium Hydroxide (R3)	0.5 ml	0.5 ml
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Mix, read the absorbance of sample (A sample) against the reagent blank after 5 minutes.

Calculation

Obtain the activity of GOT in the serum from the table

Absorbance	U/I	Absorbance	U/I
0.020	7	0.100	36
0.030	10	0.110	41
0.040	13	0.120	47
0.050	16	0.130	52
0.060	19	0.140	59
0.070	23	0.150	67
0.080	27	0.160	76
0.090	31	0.170	89



THANK YOU