

Liver function tests

Liver function tests also known as a liver panel are blood tests that measure different enzymes, proteins, and other substances made by the liver.

These tests check the overall health of your liver. The different substances are often tested at the same time on a single blood sample, and may include the following:

- **Albumin**, a protein made in the liver
- **Total protein**. This test measures the total amount of protein in the blood.
- **ALP** (alkaline phosphatase), **ALT** (alanine transaminase), **AST** (aspartate aminotransferase), and gamma-glutamyl transferase (GGT). These are different enzymes made by the liver.
- **Bilirubin**, a waste product made by the liver.
- **Lactate dehydrogenase (LD)**, an enzyme found in most of the body's cells. LD is released into the blood when cells have been damaged by disease or injury.
- **Prothrombin time (PT)**, a protein involved in blood clotting.

If levels of one or more of these substances are outside of the normal range, it may be a sign of liver disease.

Other names: liver panel, liver function panel, liver profile hepatic function panel, LFT

LFT

The liver also plays a significant role in metabolism, regulation of red blood cells (RBCs), and glucose synthesis and storage.

Alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), total bilirubin, conjugated (direct) bilirubin, unconjugated (indirect) bilirubin, prothrombin time (PT), lactate dehydrogenase, total protein, globulins, and albumin.

These tests can help determine the area of hepatic injury, and the elevation pattern can help organize a differential diagnosis.

Elevations in ALT and AST in out of proportion to ALP, and bilirubin denotes a hepatocellular disease.

An elevation in ALP and bilirubin in disproportion to ALT and AST would characterize a cholestatic pattern.

A mixed injury pattern is defined as an elevation of alkaline phosphatase and AST/ALT levels.

Isolated hyperbilirubinemia is defined as an elevation of bilirubin with normal alkaline phosphatase and AST/ALT levels.

The R ratio has been used to assess whether the pattern of liver injury is hepatocellular, cholestatic, or mixed.

An R ratio of >5 is defined as hepatocellular, <2 is cholestatic, and $2-5$ is a mixed pattern.

The actual function of the liver can be graded based on its ability to produce albumin as well as vitamin K-dependent clotting factors.

If one or more of your liver function test results were not normal, it may mean your liver is damaged or not working properly. Liver damage can be caused by a number of different conditions, including:

- Hepatitis A
- Hepatitis B
- Hepatitis C
- Alcohol use disorder, which includes alcoholism.
- Liver cancer
- Diabetes

If you have questions about your results, talk to your health care provider.

Enzymes are biocatalysts and because of their remarkable properties, they are extensively used in medical diagnosis. Researches in the last two decades have concentrated more on enzymes such as creatine kinase-MB, alanine transaminase, aspartate transaminase, acid phosphatase, alkaline phosphatase etc. for clinical applications.

Enzymes are the preferred markers in various disease states such as myocardial infarction, jaundice, pancreatitis, cancer, neurodegenerative disorders, etc.

They provide insight into the disease process by diagnosis, prognosis and assessment of response therapy.

are a group of enzymes that carry the inter conversion of amino acids and oxoacids

Aminotransferases Aminotransferases (transaminases) by the transfer of amino groups. Alanine aminotransferase(ALT), formerly known as glutamate pyruvate aminotransferase (GPT), and aspartate aminotransferase (AST), formerly known as glutamate oxaloacetate aminotransferase (GOT), are the two clinically important enzymes classified under aminotransferases.

ALANINE AMINOTRANSFERASE Among liver disorders, the most prevalent health problems are hepatitis and hepatocirrhosis, which are caused by different factors, including excessive alcohol intake, im-balanced diet, lack of exercise, insufficient sleep, and overconsumption of high calorie food[50]. In clinical diagnosis, the level of ALT (E.C. 2.6.1.2) acts as an important indicator of potential liver disease. Inside cell cytoplasm, **ALT catalyzes the reversible transamination of L-alanine and 2-oxoglutarate into pyruvate and glutamate, respectively.**

The ALT concentration range in healthy human adult is from 5 to 35 U/L, and its concentration above this range indicates a damaged/diseased liver, heart, and muscle.

Earlier, ALT concentration was determined by spectrophotometric, calorimetric, or chromatography methods. Recently, simple and low-cost paper-based analytical devices (PADs) for ALT determination have attracted the significant interest of various researchers.

ASPARTATE AMINOTRANSFERASE

The serum level of AST helps people to diagnose damaged body organs, especially the heart and liver. AST (E.C. 2.6.1.1) catalyzes the transamination of L-aspartate and 2-oxoglutarate into oxaloacetate and glutamate, respectively. In a healthy human adult, AST has a concentration of around 5–40 U/L.

However, after severe damage, the AST level rises 10–20-times higher than the normal range. AST is also found in the red blood cells, muscle tissue, and other organs, including the kidney and pancreas. It can be used in combination with other enzymes to monitor myocardial, hepatic parenchymal, and muscle diseases in humans and animals. Moreover, to screen the liver fibrosis in chronic hepatitis B, the AST-to-platelet ratio index could be a useful marker, when transient elastography is not available.

Alkaline Phosphatase (ALP)

ALP hydrolyzes the phosphate ester bonds in an alkaline environment. The rise in the level of serum ALP is a useful marker of liver disease, particularly cholestatic diseases in which bile ducts are being blocked, as in the case of obstructive jaundice

Acid Phosphatases (ACP)

Five different types of ACP, namely prostatic, erythrocytic, macrophage, ly-sosomal, and osteoclastic, are found in humans, and they differ widely with respect to their origin, molecular weight, sequence length, and resistance to tartrate and fluoride level.

Acid phosphatase is found throughout the body, but mainly in the prosthetic gland.

The prostate gland of the human male has 100 times more ACP level than in any other body tissue. Prostatic acid phosphatase is used to monitor the progress of prostate cancer, as it is strongly expressed by prostate cancer cells. Moreover, acid phosphatases are very much concentrated in semen, thus rape victims are often tested for the presence of acid phosphatase in vaginal fluid.

LACTATE DEHYDROGENASE (LDH) LDH is widely expressed in different human tissues, and it catalyzes the interconversion of pyruvate and lactate during the glycolysis and glyconeogenesis process. LDH gene expression is up regulated in many human malignant tumors, including colorectal cancer, lung cancer, breast cancer, oral cancer, prostate cancer, germ cell cancer, and pancreatic cancer. Hence, the prognostic value of the serum LDH level in cancer patients has been considered a significant topic of research recently. Moreover, LDH also acts as a prognostic marker in patients with acute leukemia and sickle cell disease

Creatine Kinase (CK)

CK is an intracellular enzyme that catalyzes the transfer of a phosphate group from creatine phosphate to ADP to generate a molecule of ATP after depletion of ATP in muscle cells. Therefore, extra energy embodied in creatine phosphate is provided to muscles by CK. Similarly, a reversible reaction of creatine phosphate is performed by CK, when muscles are at rest. CK exists in three isoforms, that is, CK-MM, CK-MB, and CK-BB; out of these, CK-MB is the most specific and accurate means of detecting myocardial infarction. In a normal, healthy male, the CK level is 0.038–0.174 U/mL, while in the case of a healthy female, it is between 0.026 and 0.14 U/mL. The serum CK concentration increases to a maximum of up to 2.0 U/mL during myocardial infarction, muscular dystrophy, and inflammatory reactions, thereby helping in the early prognosis of disease conditions.

Recently, in addition to myocardial infarction, CK-MB also acts as a biomarker in the diagnosis of uncomplicated hypertension and chronic kidney disease. Nowadays, CK-MB activity assay has been replaced by CK-MB mass assay, in which the protein concentration of CK-MB is measured, rather than its catalytic activity. Researchers around the globe are more interested in immunoassays for measuring CK-MB levels, as these analytical interferences may lead to false positive results.