

LIVER FUNCTION TESTS (LFT)

Biochemical changes for the differential diagnosis of three types of jaundice

Parameter	Hemolytic jaundice (preheptic jaundice)	Obstructive jaundice (posthepatic jaundice)	Hepatic jaundice (Intrahepatic jaundice)
Serum bilirubin	Unconjugated bilirubin ↑	Conjugated bilirubin ↑	Both ↑
van den Bergh reaction	Indirect positive	Direct positive	Biphasic
Serum enzymes	ALT, AST and ALP →	ALP ↑↑, ALT and AST marginal ↑	ALT and AST ↑↑, ALP marginal ↑
Bilirubin in urine	Not excreted	Excreted	Excreted
Urobilinogen in urine	Excretion ↑	→ or ↓	→ or ↓

ALT : Alanine transaminase; AST : Aspartate transaminase; ALP : Alkaline phosphatase; ↑ : Increase; ↓ : Decrease; → : Normal.

CONCENTRATIONS AND CHANGES IN CONCENTRATION OF BILIRUBIN AND ITS METABOLITES IN HEALTHY PERSONS AND THOSE WITH JAUNDICE

<i>Condition</i>	<i>SERUM</i>		<i>URINE</i>		
	<i>Total Bilirubin</i>	<i>Conjugated Bilirubin</i>	<i>Conjugated Bilirubin</i>	<i>Urobilinogen</i>	<i>Feces Pigment</i>
Healthy	2 to 10 mg/L	0 to 2 mg/L	Negative	0.5 to 3.4 mg/day	Brown
Prehepatic jaundice	Increased	Normal	Negative	Increased	Normal
Hepatic jaundice					
Hepatocellular disease	Increased	Increased	Positive	Decreased (normal)	Light brown
Gilbert's disease	Increased	Normal	Negative	Decreased (normal)	Normal
Crigler-Najjar syndrome	Increased	Decreased	Negative	Decreased	Light brown
Dubin-Johnson syndrome	Increased	Increased	Positive	Decreased (normal)	Light brown
Posthepatic obstructive jaundice	Increased	Increased	Positive	Decreased	Light brown

Biochemical changes during acute hepatitis

6

plasma bilirubin

plasma aminotransferases

plasma alkaline phosphatase

urinary bilirubin

urinary urobilinogen

Pre-icteric

Icteric

N/↑

↑↑

↑↑↑

↑

N

N/↑

↑

↑

↑

absent

' Biochemical changes during acute hepatitis. N = normal.

Laboratory findings in haemolytic jaundice

plasma bilirubin

plasma enzymes

plasma haptoglobins

urine urobilinogen

peripheral blood

unconjugated
rarely $>100 \mu\text{mol/L}$ except in neonates

aspartate aminotransferase
slightly increased

decreased

increased

increased reticulocytes
decreased haemoglobin
possible evidence of haemolysis on blood film

Laboratory findings in haemolytic jaundice.

Serum albumin

About 10 – 12 gm of albumin is synthesized in liver daily.

Its estimation is very valuable in assessing chronic liver disease.

Low serum albumin level is commonly observed in severe liver disease.

Prothrombin time

Normal 11 to 12 seconds

PT is prolonged in severe parenchymal liver disease due to decreased synthesis of prothrombin.

Vitamin K is required for synthesis of prothrombin.

vitamin K deficiency can also lead to prolonged PT.

Note:

If PT returns to normal after vitamin K injection it indicates that hepatocyte function is good.

Plasma proteins of diagnostic value in liver disease

Protein	Condition	Change in concentration
albumin	chronic liver disease	↓
γ -globulins	cirrhosis, especially autoimmune	↑
α_1 -antitrypsin (Inhibits elastase)	cirrhosis due to α_1 -antitrypsin deficiency	↓
caeruloplasmin 20 to 40mg/dl	Wilson's disease	↓
α -fetoprotein < 25 μ g/L	primary hepatocellular carcinoma	greatly ↑
transferrin	haemochromatosis	normal but 100% saturated with iron

Transaminases:

ALT(SGPT) 3 to 15 IU/L

AST(SGOT) 4 to 17 IU/L

ALT is primarily localized to the liver. It is the marker enzyme of the liver.

ALT is present in the cytosol of hepatocytes.

AST is present in a wide variety of tissues like heart, liver, skeletal muscle, kidney, brain.

AST is present both in the cytosol and mitochondria of the hepatocytes.

Liver contains both enzymes but more of ALT

Estimation is very useful in assessing severity and prognosis of liver parenchymal disease especially infective hepatitis.

Also very useful as screening test in outbreak of infective hepatitis.

Elevated ALT & AST

Highly elevated > 20 times

Viral hepatitis

Drug or Toxin induced hepatic necrosis

Moderately elevated - 3 to 20 times

Chronic hepatitis

Alcoholic hepatitis

Auto immune hepatitis

Acute biliary tract obstruction

Alkaline Phosphatase(ALP) - 3 to 13 KAU/dl

A family of Zinc metallo enzymes, with a serine at the active center. They release inorganic phosphate from various organic phosphates.

In the liver it is found in microvilli of bile canaliculi and on the sinusoidal surface of the hepatocytes.

Other important sources of ALP is bone.

ALP is highly elevated in obstructive jaundice and bone diseases like rickets.

γ-Glutamyl transpeptidase - Normal level 10 – 15U/L

It is a membrane bound glycoprotein which catalyses the transfer of γ- glutamyl group to other peptides and AAS.

Very useful in diagnosis of obstructive jaundice.

(not elevated in bone diseases)

It is a microsomal enzyme.

Serum GGT is highly elevated in obstructive jaundice and **alcoholic liver disease.**

This enzyme is an inducible enzyme.

5' – Nucleotidase - Normal 2 to 15 U/l

It is elevated in obstructive jaundice.

Advantage of this enzyme is that it is not elevated in bone disease.

Test for assessing detoxification function of liver.

Hippuric acid test:

Principle :

Hippuric acid is produced in the liver when benzoic acid combines with glycine.

Procedure :

6 gm of sodium benzoate is given to the patient.

Urine is collected upto 4 hours

Hippuric acid excreted in urine is estimated.

6 gm of sodium benzoate forms 7.5 gm of hippuric acid.

60% of Sodium benzoate (4.5gm of Hippuric acid) is excreted in normals.

Decreased hippuric acid excretion $< 3\text{gm}$ indicates hepatic damage.

Cirrhosis of Liver:

1. Idiopathic
2. Alcohol
3. CAH
4. Viral hepatitis
5. Wilson's disease
6. α 1-Antitrypsin deficiency

Bilirubin	Normal or Mild increase
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Total Protein	Normal
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Albumin	May decrease
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Globulins	Increase
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ALP	Highly elevated
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BSP retention at 45 minutes increased (Normal <5%)

Alcoholic Hepatitis

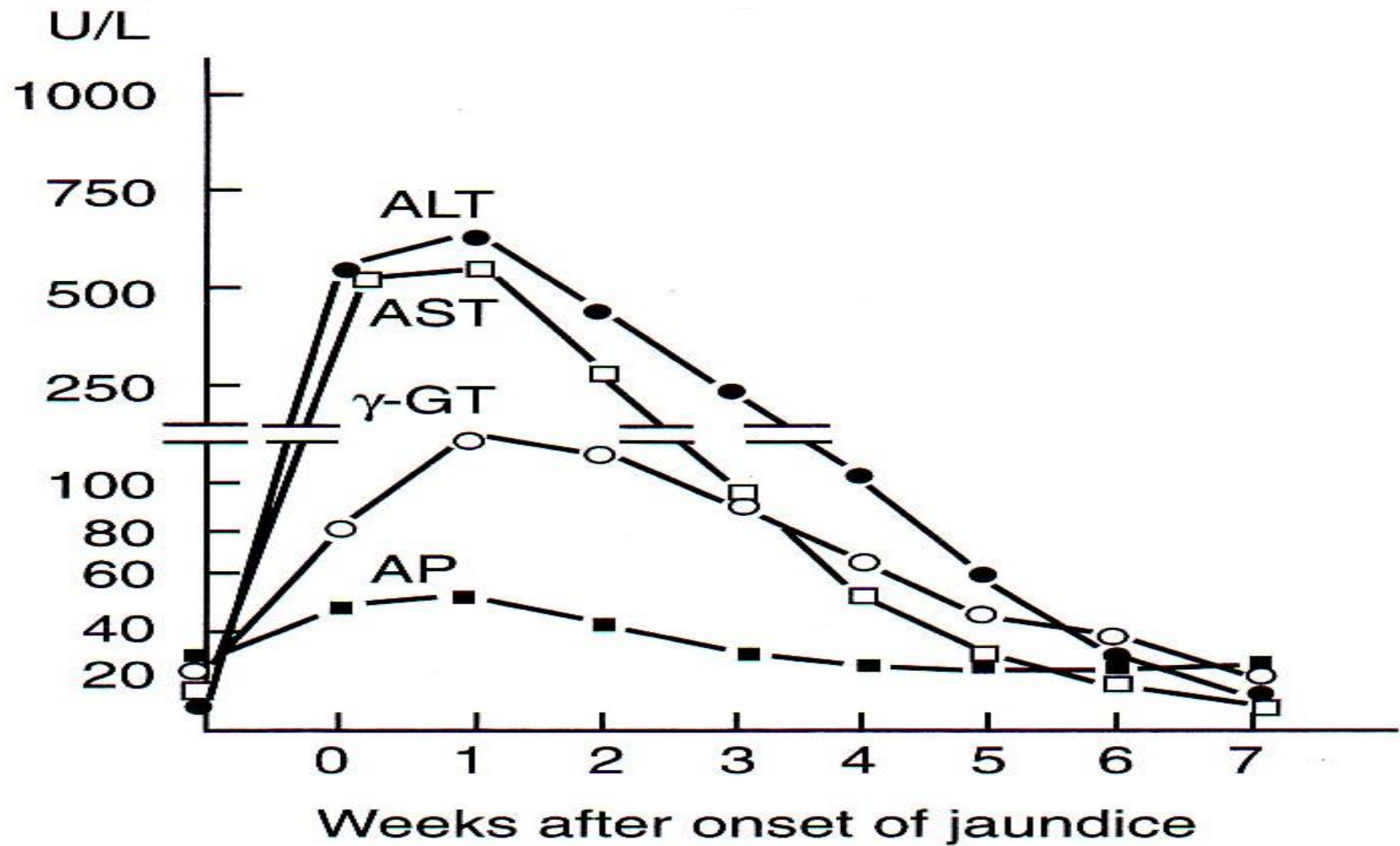
Bilirubin Mild elevation

ALP Elevated

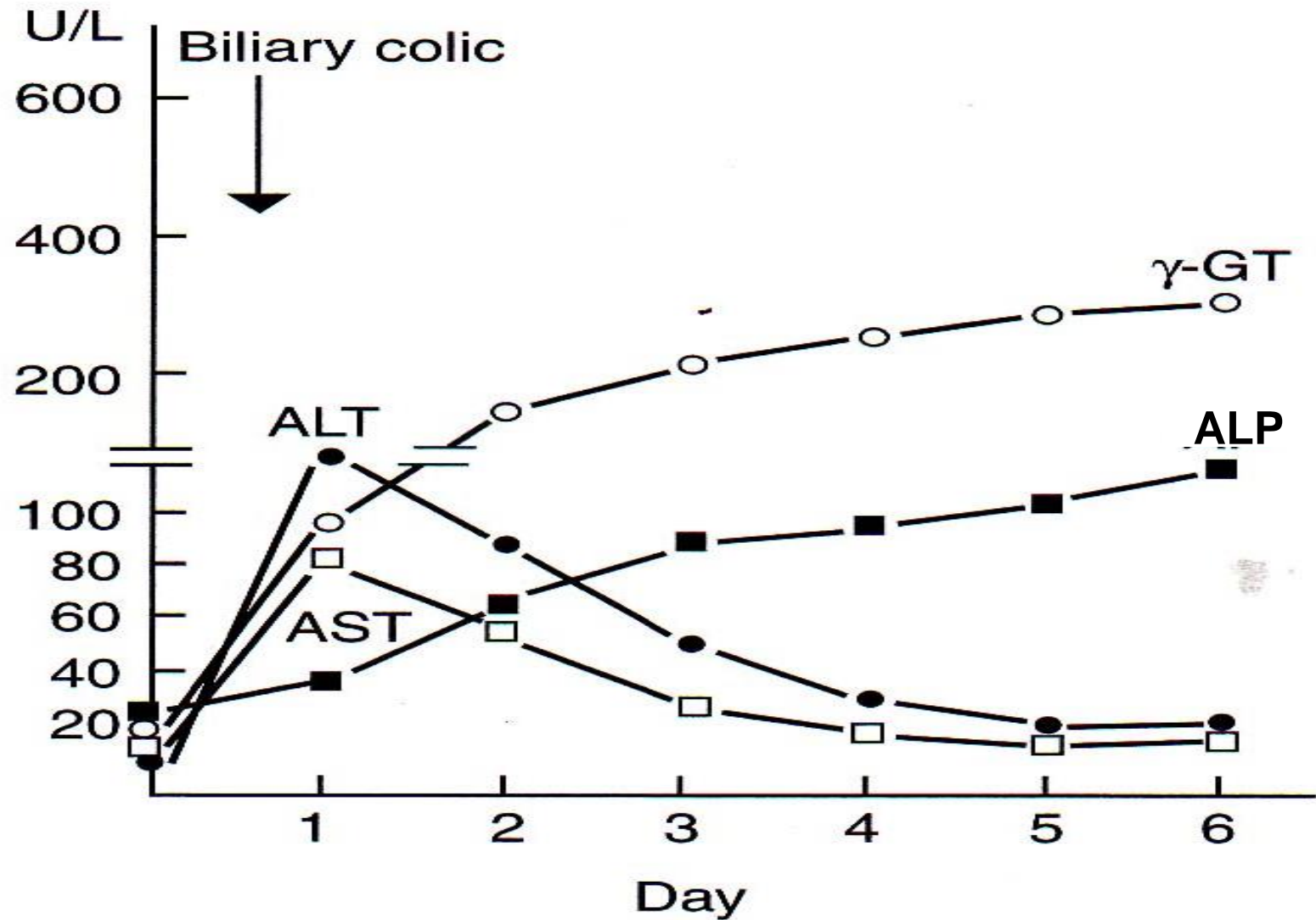
ALT Mild elevated

GGT Highly elevated

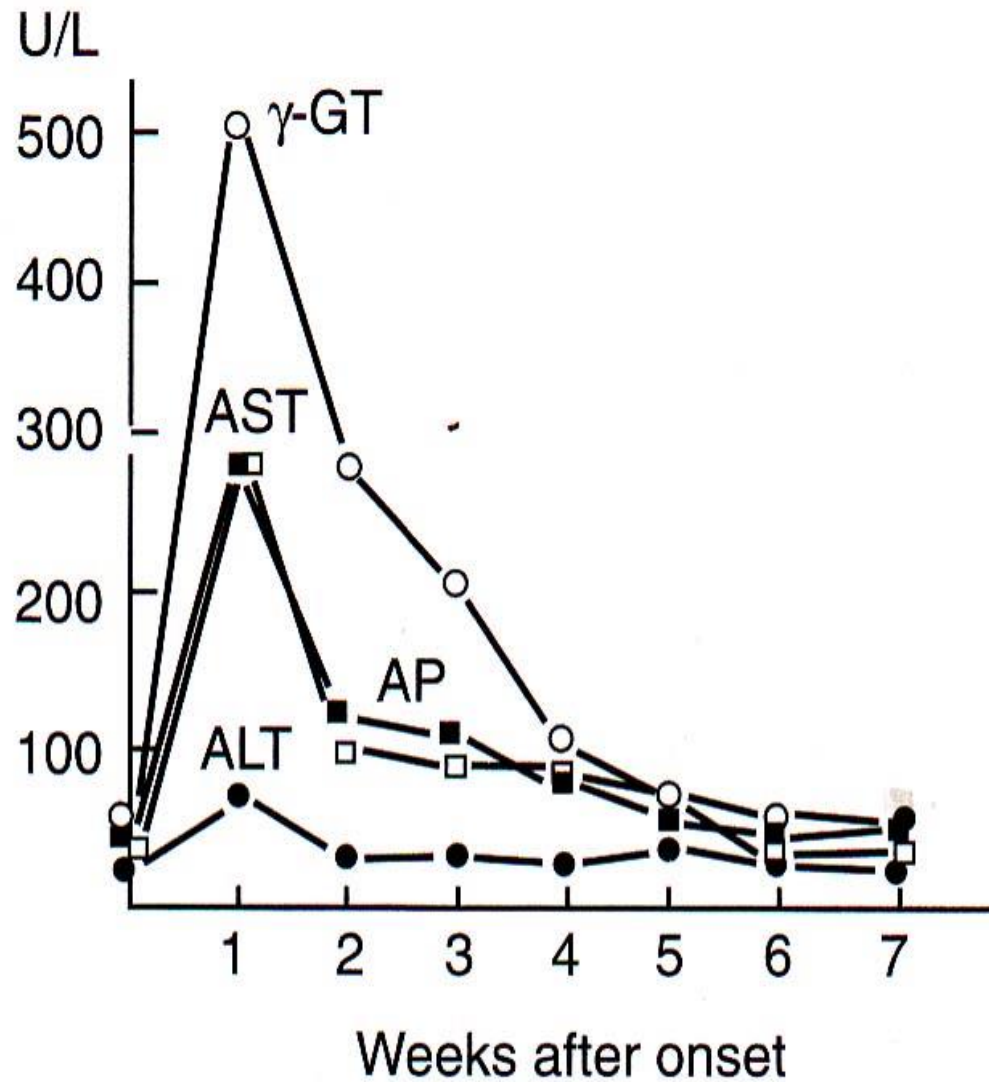
Acute Viral Hepatitis



Obstructive Jaundice



Alcoholic Hepatitis



Condition Test	Acute hepatitis	Chronic hepatitis	Cirrhosis	Cholestasis	Malignancy and infiltrations
Bilirubin	N to ↑↑	N to ↑	N to ↑	↑ to ↑↑↑	N
Aminotransferases	↑↑↑	↑	N to ↑	N to ↑	N to ↑
Alkaline phosphatase	N to ↑	N [§]	N to ↑↑	↑↑↑	↑↑
Albumin	N	N to ↓	N to ↓	N	N to ↓
γ-Globulins	N	↑	↑	N	N
Prothrombin time	N to ↑*	N to ↑	N to ↑*	N to ↑ [†]	N

Patterns of abnormalities of simple liver function tests in various liver diseases. The severity of the abnormalities is dependent on the degree of liver damage and its effect on liver function.

N = Normal

* Not corrected by parenteral vitamin K.

§ May be increased if cirrhosis is present.

† Corrected by parenteral vitamin K.