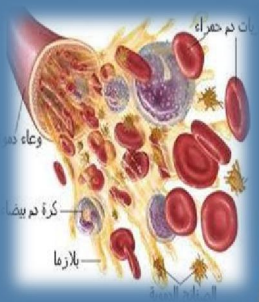
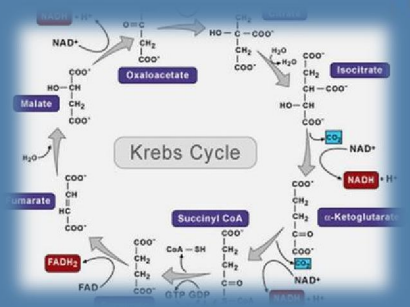
Al-Rasheed University College
Medical Analysis Department
Clinical Chemistry Lab.
Third Stage

كليـــــة الرشيد الجامعـــــــة
قســـــم التحليلات المرضيـــة
مختبر الكيميـــاء السريريـــة
المرحلـــــة الثالثـــــة





Lecture (6)

Liver Function:
- Gamma Glutamyl Transferase (GGT)
- Alkaline phosphatase

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Gamma-Glutamyl Transferase (GGT)

❶ Clinical Significance:

Gamma-glutamyl transferase (GGT) is an enzyme that is found in many organs throughout the body, with the highest concentrations found in the liver. GGT is elevated in the blood in most diseases that cause damage to the liver or bile ducts. This test measures the level of GGT in a blood sample.

Normally, GGT is present in low levels, but when the liver is injured, the GGT level can rise. GGT is usually the first liver enzyme to rise in the blood when any of the bile ducts that carry bile from the liver to the intestines become obstructed, for example, by tumors or stones. This makes it the most sensitive liver enzyme test for detecting bile duct problems.

However, the GGT test is not very specific and is not useful in differentiating between various causes of liver damage because it can be elevated with many types of liver diseases, such as liver cancer and viral hepatitis, as well as other non-hepatic conditions, such as acute coronary syndrome. For this reason, the GGT test is not recommended for routine use by itself. However, it can be useful in conjunction with other tests and in determining the cause of a high alkaline phosphatase (ALP) level, another enzyme found in the liver.

Both GGT and ALP are increased in liver diseases, but only ALP will be increased with diseases affecting bone tissue. Therefore, GGT can be used as a follow up to an elevated ALP to help determine if the high ALP result is due to liver or bone disease.

GGT levels are sometimes increased with consumption of even small amounts of alcohol. Higher levels are found more commonly in chronic heavy drinkers than in people who consume less than 2 to 3 drinks per day or who only

drink heavily on occasion (binge drinkers). The GGT test may be used in evaluating someone for acute or chronic alcohol abuse.

The gamma-glutamyl transferase (GGT) test may be used to determine the cause of elevated alkaline phosphatase (ALP). Both ALP and GGT are elevated in disease of the bile ducts and in some liver diseases, but only ALP will be elevated in bone disease. Therefore, if the GGT level is normal in a person with a high ALP, the cause of the elevated ALP is most likely bone disease.
The GGT test is sometimes used to help detect liver disease and bile duct obstructions. It is usually ordered in conjunction with or as follow up to other liver tests such as ALT, AST, ALP, and bilirubin. (Read also about the Liver Panel.) In general, an increased GGT level indicates that a person's liver is being damaged but does not specifically point to a condition that may be causing the injury.

GGT can be used to screen for chronic alcohol abuse (it will be elevated in about 75% of chronic drinkers) and to monitor for alcohol use and/or abuse in people who are receiving treatment for alcoholism or alcoholic hepatitis.

⊙ The purpose of test ordered:

A GGT test may be ordered when someone has an elevated ALP level. An ALP test may be ordered alone or as part of a routine liver panel to screen for liver damage, even if no symptoms are present. A GGT test may be ordered when results of the ALP test are high but other tests that are part of the liver panel (such as AST and ALT) are not increased.

GGT may be ordered along with or as a follow up to other liver function tests when a person has signs or symptoms that suggest liver disease. Some signs and symptoms of liver damage include:

- Weakness, fatigue

- Loss of appetite
- Nausea and vomiting
- Abdominal swelling and/or pain
- Jaundice
- Dark urine, light-colored stool
- Itching (pruritus)

GGT may also be ordered when someone with a history of alcohol abuse has completed alcohol treatment in order to monitor compliance with the treatment program.

⦿ Causes and investigation of abnormal results:

An elevated GGT level suggests that a condition or disease is damaging the liver but does not indicate specifically what. In general, the higher the level, the greater the damage to the liver. Elevated levels may be due to liver diseases, such as hepatitis or cirrhosis, but they may also be due to other conditions, such as congestive heart failure, diabetes, or pancreatitis. They may also be caused by alcohol abuse or use of drugs that are toxic to the liver.

A low or normal GGT test result indicates that it is unlikely that a person has liver disease or has consumed any alcohol.

A high GGT level can help rule out bone disease as the cause of an increased ALP level, but if GGT is low or normal, then an increased ALP is more likely due to bone disease.

Alkaline phosphatase

Alkaline phosphatase (ALP) is an enzyme found in your bloodstream. ALP helps break down proteins in the body and exists in different forms, depending on where it originates. It is mostly produced in your liver, but some is also made in your bones, intestines, and kidneys. In pregnant women, ALP is made in the placenta.

➲ The Purpose of ALP Test:

An ALP test may be performed to determine how well your liver is functioning or to identify problems with your bones.

❶ Liver

Checking ALP levels in the blood is a routine part of a liver function test used to determine if your liver is diseased or damaged. Symptoms such as jaundice (yellowing of the skin and eyes), abdominal pain, vomiting, and nausea may lead your doctor to suspect there is something wrong with your liver or gallbladder.

The ALP test can be helpful in identifying conditions such as:

- hepatitis (inflammation or infection of the liver).
- cirrhosis (scarring of the liver).
- inflammation of the gallbladder.
- blockage of bile ducts (from gallstone, inflammation, or cancer).

You may also need an ALP test if you are taking a medication that has the potential to damage your liver, such as acetaminophen (Tylenol). Measuring ALP is one way to check for that damage.

❷ **Bones**

The ALP test can be helpful in the diagnosis of bone problems such as:

- Rickets: weakening of bones due to deficiency of calcium, phosphate, or vitamin D.
- Osteomalacia: softening of the bones due to vitamin D deficiency or the body's inability to break down the vitamin properly.
- Paget's disease: disorder causing major problems with bone destruction and re-growth.

ALP testing can also be helpful in investigating vitamin D deficiency, the presence of tumors, or unusual bone growth. It can also be used to check the progress of treatment for any of the above conditions.

Test Requirements:

In this test, you will probably be asked to fast for 10 hours before the test. Eating and drinking can interfere with your ALP levels. Medications can also change your ALP levels, so be sure to tell your doctor about all medicines you are taking.

Test Results Mean:

➲ **High Levels**

Higher-than-normal levels of ALP in your blood may indicate a problem with your liver. This could include **hepatitis** (infection), **cirrhosis** (scarring), liver cancer, gallstones, or a blockage in your bile ducts.

High levels may also indicate an issue related to the bones such as rickets, Paget's disease, bone cancer, or an overactive parathyroid gland. In rare cases, high ALP levels can indicate heart failure, kidney cancer, mononucleosis, or a blood infection.

➲ **Low Levels**

Having lower-than-normal ALP levels in your blood is rare, but can indicate malnutrition, which could be caused by celiac disease or a deficiency in vitamins and minerals.

Principle of the method:

Colorimetric determination of alkaline phosphatase activity according to the following reaction:

$$phenlphosphate \xrightarrow{Alkaline\ phosphate/PH=10} phenol + phosphate$$

The liberated phenol is measured in the presence of 4-aminoantipyrine and potassium ferricyanide. The presence of sodium arsenate in the reagent stops the enzymatic reaction.

Normal Value:

Children: 71-142 U/l, Adults: 21-92 U/l

Procedure:

➲ Assay conditions:

- Wavelength …… 510 nm (530-580).
- Cuvette ……... 1 cm light path.

➲ Pipette into a cuvette:

	Serum sample	Serum blank	standard	Reagent blank
R (1)	**2 ml**	**2 ml**	**2 ml**	**2 ml**
Incubate 5 min at 37 ºC				
serum	**50 µL**	**-----**	**-----**	**-----**
R (2)	**-----**	**-----**	**50 µL**	**-----**
Incubate exactly 15 min at 37 ºC				
R (3)	**0.5 ml**	**0.5 ml**	**0.5 ml**	**0.5 ml**
Mix well or preferably vortex				
Reagent (4)	**0.5 ml**	**0.5 ml**	**0.5 ml**	**0.5 ml**
Serum	**-----**	**50 µL**	**-----**	**-----**
Distilled	**-----**	**-----**	**-----**	**50 µL**
Mix and stand for 10 min in the dark Measure				

- n = 142 U/l
- Calculation: $\frac{\text{O.D serum sample} - \text{O.D serum Blank}}{\text{O.D Standard}} \times \mathbf{n} = \mathbf{-\ U/l}$