

*Al-Rasheed University College
Department of Dentistry*



practical Biochemistry

For the second class

lab 5

Alkaline Phosphatase



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alkaline phosphatase activity caused by increased osteoblast activity following accelerated bone growth is sometimes seen in children and juveniles.

Normal ALP levels in adults are approximately 20 to 140 IU/L (3-13 KAU), though levels are significantly **higher in children and pregnant women**. **High** ALP levels can occur if the **bile ducts are obstructed**. Also, ALP increases if there is **active bone formation** occurring, as ALP is a byproduct of osteoblast activity (such as the case in Paget's disease of bone).

Lowered levels of ALP are less common than elevated levels. The source of elevated ALP levels can be deduced by obtaining serum levels of gamma glutamyltransferase (GGT). Concomitant increases of ALP with GGT should raise the suspicion of hepatobiliary disease

Why the test is done?

Alkaline phosphatase is used commonly as an index of liver and bone disease in correlation with other clinical findings. A test for alkaline phosphatase (ALP) is done to:

- **Check for liver disease or damage to the liver.** Symptoms of liver disease can include jaundice, belly pain, nausea, and vomiting. An ALP test may also be used to check the liver when medicines that can damage the liver are taken.
- **Check bone problems** (sometimes found on X-rays), such as rickets, bone tumors, Paget's disease, or too much of the hormone that controls bone growth (parathyroid hormone). The ALP level can be used to check how well treatment for Paget's disease or a vitamin D deficiency is working.

What Affects the Test

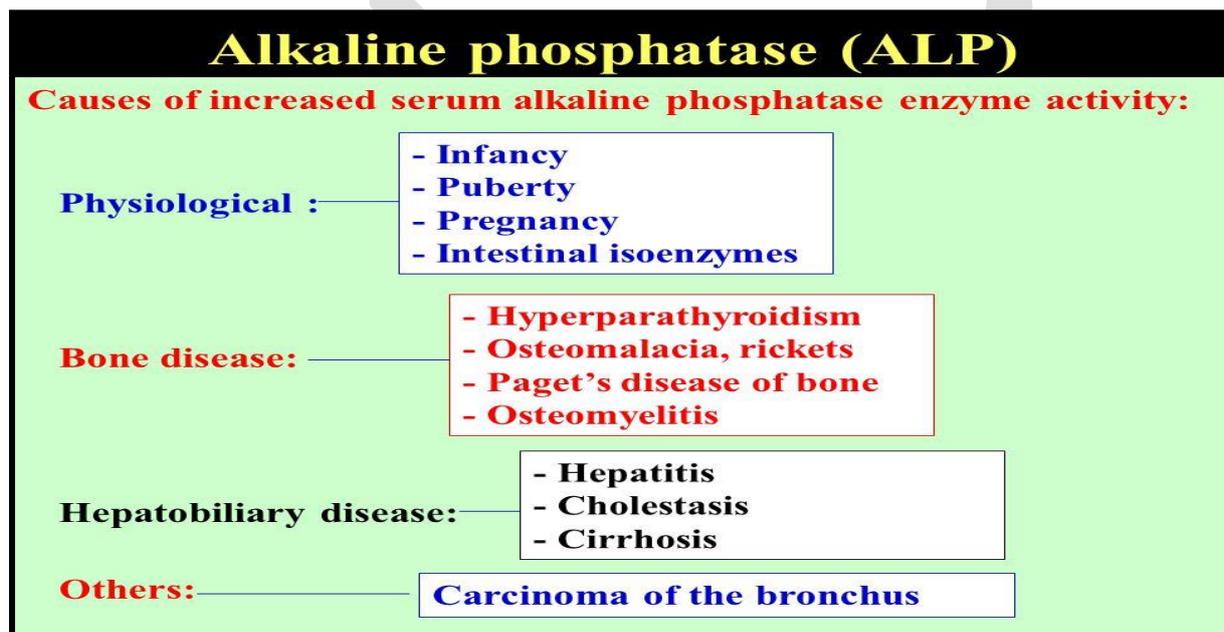
The results may not be helpful include:

- **Medicines that may damage the liver**, such as some antibiotics, birth control pills, long-term aspirin use, and oral diabetes medicines.
- **Going through menopause.** Postmenopausal women may have higher ALP levels than women who still have menstrual cycles.
- **The age.** Children normally have much higher ALP levels than adults because rapid bone growth is normal in children and bones make ALP.
Drinking a lot of alcohol.

Other tests to check liver function, such as alanine aminotransferase, aspartate aminotransferase, and bilirubin, are often done at the same time as an alkaline phosphatase (ALP) test.

- Alanine Aminotransferase (ALT)
- Aspartate Aminotransferase (AST)
- Bilirubin
- Gamma glutamyl transferase (GGT), or gamma glutamyl transpeptidase, may be measured in the blood to check the difference between bone ALP and liver ALP. High levels of GGT are present when the liver is damaged but not present with bone disease. A high level of GGT may be caused by alcohol use or may mean that blocked bile ducts are causing inflammation. The level of GGT may be high with the use of certain medicines, such as phenytoin and phenobarbital. In some medical centers, a test that measures a substance called 5-nucleotidase is done instead of the GGT test because it is better at finding liver disease.

In bone disease, the enzyme level rises in proportion to new bone cells production that results from osteoblastic activity and the deposit of calcium in the bones. In the liver diseases, the blood level rises when the excretion of this enzyme is impaired as a result of obstruction in the biliary tract.



Clinical implications:

- 1. Elevated levels in liver disease:**
 - a. Obstructive jaundice
 - b. Hepatic carcinoma and malignancy with liver metastasis
 - c. Hepatocellular cirrhosis
 - d. Intrahepatic and extrahepatic cholestasis
 - e. Hepatitis, infectious mononucleosis

2. Elevated levels in bone disease:

- a. Osteomalacia and rickets
- b. Paget`s disease
- c. Metastatic bone tumor
- d. Osteogenic sarcoma
- e. Healing of bone fractures

3. Elevated levels in other diseases:

- a. Hyperparathyroidism
- b. Ulcerative colitis
- c. Chronic renal failure
- d. After a fatty meal, there is a small increase due to release of intestinal ALP.

4. Decreased levels in the following conditions:

- a. Hypophosphatasia
- b. Scurvy, Malnutrition
- c. Hypothyroidism

Alkaline phosphatase isoenzymes :

Isozymes (also known as isoenzymes or more generally as Multiple forms of enzymes) are enzymes that **differ in amino acid sequence but catalyze the same chemical reaction**. These enzymes usually display different kinetic parameters (e.g. different K_M values), or different regulatory properties. The existence of isozymes permits the fine-tuning of metabolism to meet the particular needs of a given tissue or developmental stage. In biochemistry, isozymes (or isoenzymes) are isoforms (closely related variants) of enzymes.

If ALP results are **increased but it is not clear** whether this is due to liver or bone disease, tests for ALP isoenzymes may be done to determine the cause.

There are many different forms of ALP called isoenzymes. The structure of the enzyme depends on **where in the body it is produced**. This test is most often used to test ALP made in the tissues of the liver and bones.

Methods for the Separation and Quantification of Alkaline Phosphatase Isoenzymes

- Assays for ALP isoenzymes are needed when:
 - the source of an elevated ALP in serum is not obvious
 - to monitor the disease activity and the effect of appropriate therapies
- Electrophoretic mobility
- Stability to denaturation by heat or chemicals
- Response to the presence of selected Inhibitors

In humans, alkaline phosphatase is present in all tissues throughout the entire body, but is particularly concentrated in liver, bile duct, kidney, bone, and the placenta. Humans and most other mammals contain the following alkaline phosphatase isoenzymes:

- **ALPI** – intestinal.
- **ALPL** – tissue-nonspecific (liver/bone/kidney).
- **ALPP** – placental (Regan isoenzymes).

Alkaline Phosphatase (ALP)

- Isoenzymes are **five**:
 1. **ALP-1** present in **liver** increased in obstructive jaundice, biliary cirrhosis.
 2. **ALP-2** in **bone** increased in rickets and Pagets
 3. **ALP-3** in **placenta** increase in 2nd and 3rd trimester of pregnancy and decrease indicates placental insufficiency and foetal death.



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