INTERPRETATION OF CARDIAC ENZYMES:

Certain enzymes (CPK, LDH, and SGOT) are released from the heart muscle cells when it is injured ("heart attack"). These enzymes are normally found in the blood at low levels. The abnormal elevation of these enzymes in the blood stream can occasionally be the only indicator that a heart attack (myocardial infarction) has occurred.

For heart attacks, measuring the levels of cardiac enzymes in the blood is a common test for the diagnosis of a heart attack and the amount the damage done to the heart; the medical field considers the measurement of cardiac enzyme levels in the blood to be a reliable test for a heart attack.

However, it is important to know that cardiac enzymes leak slowly into the blood, and unusually high levels of cardiac enzymes in the blood may not appear until six or more hours after the onset of a heart attack. Thus, if a person has chest pain but has normal levels of cardiac enzymes in the blood, a heart attack cannot be ruled out. In that instance, repeated cardiac enzymes tests are normally conducted to confirm diagnosis of a heart attack.

Following are the main cardiac enzymes:

1. SGOT
2. LDH (also called LD)
3. CPK (also called CK)
4. Troponin

TEST: SGOT

Serum Glutamic Oxaloacetic Transaminase, called: AST, (Aspartate Aminotransferase) A blood chemistry test for the level of SGOT in blood (is released with tissue necrosis).

Normal Values: 5-40 U/ml (Frankel) 4-36 IU/L; or 16-60 (Karmen) U/ml U/L at 30 degrees C; or 8-33 (SI units) at 37 degrees C.

CLINICAL IMPLICATIONS:
This enzyme shows an elevation 8-12 hours after infarction. Peak levels are reached 24-48 hours after the MI. This enzyme is not particularly indicative of an MI. Other conditions can also cause a rise in the levels. High levels of SGOT may be obtained with trauma to the skeletal muscles, in liver disease, pancreatitis and others. SGOT is found in: heart muscle, liver, some also in skeletal muscle, kidneys and the pancreas. Demerol and morphine may elevate the levels temporarily. This enzyme then is used with other enzyme results to more definitely diagnose the MI. AST levels elevate in 6-10 hours following acute MI. They peak in 24 to 48 hours.

**TEST: LDH, LACTIC DEHYDROGENASE:**

An intracellular enzyme present in nearly all metabolizing cells in the body. The highest concentration of enzyme is located in the heart, skeletal muscle, liver, kidney, brain, and erythrocytes. There are 5 isoenzymes of LDH. This is a blood chemistry test to measure the amount of enzyme in the blood.

LDH catalyzes the reversible conversion of muscle lactic acid into pyruvic acid, an essential step in the metabolic process that ultimately produces cellular energy. Because LDH is present in almost all body tissues, cellular damage increases total serum LDH, limiting the diagnostic usefulness of this test.

Isoenzymes LD1 and LD2 appear primarily in the heart, red blood cells and kidneys. LD3 is primarily in the lungs. LD4 and LD5 are located in the liver, skin, and the skeletal muscles.

**NORMAL VALUES:**

Total LDH: 150-450 U/ml (Wroblewski-LaDue method), 60-120 U/ml (Wacker method) 70-200 IU/L--results are different according to method used. Newborn: 300-1500IU/L Child: 50-150 IU/L

- LD1---17.5% to 28.3% of total
- LD2---30.4% to 36.4% of total
- LD3---19.2% to 24.8% of total
- LD4----9.6% to 15.6% of total

Because many common diseases increase total LDH (LD) levels, isoenzyme electrophoresis is usually necessary for diagnosis. In some disorders, total LDH may be within normal limits, but abnormal proportions of each enzyme indicate specific organ tissue damage. For example, in acute MI, the LD1 and LD2 isoenzyme ratio is typically greater than 1 within 12 to 48 hours after onset of symptoms (known as flipped LD). Midzone fractions (LD2, LD3, and LD4) can be increased in granulocytic leukemia, lymphomas, and platelet disorders.

**CLINICAL IMPLICATIONS:**

The total LDH may be influenced by other body tissues, other than the heart. Therefore, the LDH is split into its fractions, isoenzymes, in order to isolate the particular one which is located almost...
solely in the myocardium. This isoenzyme is the number 1 isoenzyme. Although not foolproof, if this isoenzyme is elevated, it is strongly indicative of an MI. LDH elevates in 24-48 hours and peaks in 48-72 hours after the episode.

Narcotic drugs and IM injections can elevate serum LDH levels. Hemolysis of the blood can cause an elevated LDH because LDH is plentiful in the erythrocytes.

Again, with this enzyme, it is important to gather a detailed patient history. Find out if there has been injury to any systems which might elevate the LDH levels. These include: trauma, cancers, leukemia, hepatitis, shock, heat stroke, sickle cell disease.

**TEST: CPK, CREATINE PHOSPHOKINASE (CK) CREATINE KINASE**

This is a blood chemistry test to measure the amount of enzyme in the blood. The CPK enzyme is found in high concentration in heart and skeletal muscle; low concentration is brain tissue. CPK is an enzyme that catalyzes the creatine-creatinine metabolic pathway in muscle cells and brain tissue. Because of its intimate role in energy production, CPK reflects normal tissue catabolism; increased serum levels indicate trauma to cells.

**NORMAL VALUES:**

- male: 5-35 µg/ml (mcg/ml);
- female: 5-25 µg/ml
- newborn: 10-300 IU/L

**CLINICAL IMPLICATIONS:**

Serum CPK/CK will be elevated in skeletal muscle disease, in acute MI, in cerebral vascular disease, vigorous exercise, IM injections, electrolyte imbalance, and hypokalemia. CPK has three isoenzymes as presented earlier. Fractionation and measurement of these three distinct CPK isoenzymes have replaced the use of total CK (or CPK) levels to accurately localize the site of increased tissue destruction. CK-BB is most often found in brain tissue. CK-MM and CK-MB are found primarily in skeletal and heart muscle. In addition, subunits of CK-MB and CK-MM, called isoforms or isoenzymes, can be assayed to increase the test's sensitivity.

These isoenzymes are:

1. CK-BB (CK1) Isoenzyme #1
2. CK-MB (CK2) Isoenzyme #2
3. CK-MM (CK3) Isoenzyme #3

When the isoenzyme CPK-MB is elevated, greater than 5%, it could strongly indicate damage to the myocardial cells. The CPK-MB elevates within 4-6 hours after an acute MI; peaks in 18-24
hours; it then returns to normal within 3-4 days. It is best to avoid IM injections, even though the injections will usually not cause elevation of the CPK-MB. This is because other enzymes can be affected by the injections, and other enzyme studies are performed in conjunction with the CPK studies. Trauma and surgery will elevate the CPK levels.

**TEST: TROPONIN:** The Troponin test is considered the most accurate cardiac enzyme test in the diagnosis of a heart attack. It is the most sensitive and specific test for myocardial damage. Because it has increased specificity compared with CK-MB, troponin is a superior marker for myocardial injury.

**CLINICAL IMPLICATIONS:**

Troponin is the first elevated substance than any other enzymes. It is released during MI from the cytosolic pool of the myocytes. Its subsequent release is prolonged with degradation of actin and myosin filaments. Differential diagnosis of troponin elevation includes acute infarction, severe pulmonary embolism causing acute right heart overload, heart failure, and myocarditis. Troponins can also calculate infarct size but the peak must be measured in the 3rd day. It released in 2–4 hours and persists for up to 7 days.

However, one should note that cardiac enzymes leak slowly into the blood, and unusually high levels of cardiac enzymes in the blood may not appear until six or more hours after the onset of a heart attack. Thus, if a person has chest pain but has normal levels of cardiac enzymes in the blood, a heart attack cannot be ruled out. In that instance, repeated cardiac enzymes tests are normally conducted to confirm diagnosis of a heart attack.

**REFERENCES**

Lippincott’s Biochemistry (5th edition)

Pg : (66-67)

**THANK YOU**