Cardiac Enzymes

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First We Will Start With :

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Introduction:

- 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 and Protein :

- Myoglobin
- LDH (also called LD)
- CPK (also called CK)
- Troponin
- SGOT

Myoglobin

is an iron- and oxygen-binding protein found in the muscle tissue and in almost all mammals. It is related to hemoglobin, which is the iron- and oxygen-binding protein in blood, specifically in the red blood cells. The only time myoglobin is found in the bloodstream is when it is released following muscle injury. It is an abnormal finding, and can be diagnostically relevant when found in blood .

Clinical implications

MYOGLOBIN IS relatively small protein that is relased into the serum as early as 1 hours after AMI reaches a peak in the range of 4 to 12 hours then is rapidly cleared.
The major advantage of the Myoglobin is a cardiac marker because it is relased from the damaged cells earlier that other cardiac markers permitting earlier detection of AMI
Rapid relase of myoglobin is probably reflects its low molecular weight and cytoplasmic location

Myoglobin as an earlier marker of AMI exhibits a high negative predictive value , the main reason that myoglobin has not been used by most hospitals for the evaluation of chest pain is its poor clinical specifity (60% - 90%)

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.
- 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.

Now We Will Continue With

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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

Clinical implication

- 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.
- If this 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.

CPK, Creatine Phosphokinase (CK) Creatine Kinase

- Creatine kinase is a dimer with M (muscle) and/or B (brain) subunits; it exists in three isoenzyme forms: CK-MM, the predominant form, found primarily in skeletal muscle; CK-MB, found in cardiac muscle, tongue, diaphragm, and in small amounts in skeletal muscle; and CK-BB found in the brain, smooth muscle, thyroid, lungs, and prostate. Elevations detected by electrophoresis or other methodologies can be used to help in the differential diagnosis of a variety of disease states, with CK-MB elevations as an important marker following myocardial infarctions, elevations in CK-MM an indicator of muscle disease, and increases in CK-BB an occasional finding following brain infarcts, bowel infarcts, or in the presence of certain malignancies.

- The CPK enzyme is found in high concentration in heart and skeletal muscle; low concentration in 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

Lastly…

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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

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.

SGOT

- Serum Glutamic Oxaloacetic Transaminase, called: AST, (Aspartate Aminotransferase)
- Normal Values: 5-40 U/ml (Frankel) 4-36 IU/L 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 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.

THANX FOR LISTENING