

Overview

Useful For

Investigating a variety of diseases involving the heart, liver, muscle, kidney, lung, and blood

Differentiating heart-synthesized lactate dehydrogenase (LD) from liver and other sources

Investigating unexplained causes of LD elevations

Detection of macro-LD

Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
LD	Lactate Dehydrogenase (LD), S	Yes	Yes
LDI	LD Isoenzymes, S	No	Yes

Special Instructions

- [Biochemical Genetics Patient Information](#)

Method Name

LDI: Electrophoresis Densitometry

LD: Photometric Rate

NY State Available

Yes

Specimen

Specimen Type

Serum

Necessary Information

Patient's age is required.

Specimen Required

Container/Tube:

Preferred: Serum gel

Acceptable: Red top

Specimen Volume: 2 mL divided into 2 tubes each containing 1 mL

Forms

[Biochemical Genetics Patient Information](#) (T602) in Special Instructions

Specimen Minimum Volume

0.75 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Ambient (preferred)	7 days	
	Refrigerated	48 hours	

Clinical & Interpretive

Clinical Information

[Total Lactate Dehydrogenase \(LD\):](#)

LD activity is present in all cells of the body with highest concentrations in heart, liver, muscle, kidney, lung, and erythrocytes. As with other proteins used as tissue-function markers, the appearance of LD in the serum occurs only after prolonged hypoxia and is elevated in a number of clinical conditions including cardiorespiratory diseases, malignancy, hemolysis, and disorders of the liver, kidneys, lung, and muscle.

Isoenzymes:

LD is a tetrameric cytoplasmic enzyme, composed of H and M subunits. The usual designation of the isoenzyme is LD-I (H4), LD-II (H3M), LD-III (H2M2), LD-IV (HM3), and LD-V (M4). Tissue specificity is derived from the fact that tissue-specific synthesis of subunits occurs in well-defined ratios. Most notably, heart muscle cells preferentially synthesize H subunits, while liver cells synthesize M subunits nearly exclusively. Skeletal muscle also synthesizes largely M subunits so that LD-V is both a liver and skeletal muscle form of LD. The LD-I and LD-V forms are most often used to indicate heart or liver pathology, respectively.

LD-I appears elevated in the serum about 24 to 48 hours after a myocardial infarction (MI), but is generally not as useful as troponin for detection of MI, unless the MI occurred at least 24 hours prior to testing. Normally, LD-II is greater than LD-I; however, when a MI has occurred, there is a "flip" in the usual ratio of LD-I/LD-II from less than 1 to greater than 1 (or at least >0.9). Use of the ratio for evaluation of patients with possible cardiovascular injury has largely been replaced by TRPS/Troponin T, 5th Generation, Plasma.

The LD-V form is pronounced in patients with either primary liver disease or liver hypoxia secondary to decreased perfusion, such as occurs following an MI. However, LD-V is usually not as reliable as the transaminases (eg, aspartate aminotransferase, alanine aminotransferase) for evaluating liver function. LD-V also may be elevated in muscular damage and diseases of the skin.

Although it does not appear to cause or be associated with any symptoms or particular diseases, the presence of macro-LD (LD combined with an immunoglobulin) can cause an idiosyncratic elevation of total LD.

Reference Values**LACTATE DEHYDROGENASE (LD)**

1-30 days: 135-750 U/L

31 days-11 months: 180-435 U/L

1-3 years: 160-370 U/L

4-6 years: 145-345 U/L

7-9 years: 143-290 U/L

10-12 years: 120-293 U/L

13-15 years: 110-283 U/L

16-17 years: 105-233 U/L

> or =18 years: 122-222 U/L

LD ISOENZYMES

I (fast band): 17.5-28.3%

II: 30.4-36.4%

III: 19.2-24.8%

IV: 9.6-15.6%

V (slow band): 5.5-12.7%

Interpretation

Marked elevations in lactate dehydrogenase (LD) activity can be observed in megaloblastic anemia, untreated pernicious anemia, Hodgkin disease, abdominal and lung cancers, severe shock, and hypoxia.

Moderate-to-slight increases in LD levels are seen in myocardial infarction (MI), pulmonary infarction, pulmonary embolism, leukemia, hemolytic anemia, infectious mononucleosis, progressive muscular dystrophy (especially in the early and middle stages of the disease), liver disease, and renal disease.

In liver disease, elevations of LD are not as great as the increases in aspartate amino transferase and alanine aminotransferase.

Increased levels of the enzyme are found in about one-third of patients with renal disease, especially those with tubular necrosis or pyelonephritis. However, these elevations do not correlate well with proteinuria or other parameters of renal disease.

On occasion, a raised LD level may be the only evidence to suggest the presence of a hidden pulmonary embolus.

Isoenzymes:

LD-II is found in myocardium. Following a severe MI, the diagnostic ratio of LD-I divided by LD-II will change from less than 0.9 to greater than 0.9. This is referred to as an LD "flip".

LD-I elevation not due to myocardial damage may indicate hemolytic disease or other forms of in vivo hemolysis.

Elevation of LD-V (least mobile isoenzyme) usually denotes liver damage. It is rarely helpful in defining skeletal muscle disease.

Macro-LD can occur, which results in an elevation of LD for no clinical reason. Macro-LD greatly affects the migration of LD isoenzymes since the addition of an immunoglobulin molecule greatly retards the migration of the usual LD isoenzymes. If macro-LD is present, the electrophoretogram will show atypically migrating isoenzymes with LD activity localized near the origin.

Cautions

A hemolyzed specimen is not acceptable as red blood cells contain much more lactate dehydrogenase (LD) than serum. Causes of hemolysis can include transportation via pneumatic tube, vigorous mixing, or traumatic venipuncture. Tubes should be void of air bubbles to prevent minor hemolysis. LD activity is one of the most sensitive indicators of in vitro hemolysis. Hemolysis causes anomalous elevation of LD-I such that any ex vivo hemolysis must be strictly avoided.

Testing should be used with caution in patients with chronic hemolytic anemias such as sickle cell disease as LD levels may be falsely elevated due to their clinical status.

Freezing or prolonged storage at 4 degrees C (>12 hours) causes LD-V to be lost.

Elevations of intermediate forms, LD-II through LD-IV, are rarely used to define a tissue of origin and such reports are largely anecdotal.

While increases in serum LD also are seen following a myocardial infarction, the test has been replaced by the determination of troponin (TRPS / Troponin T, 5th Generation, Plasma).

Clinical Reference

1. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Edited by CA Burtis, ER Ashwood. Philadelphia, WB Saunders Company, 2006
2. Berridge BR, Herman E: In Haschek and Rousseaux's Handbook of Toxicologic Pathology. Third Edition. 2013

Performance**Method Description**

Photometric Rate:

Lactate and NAD⁺, in the presence of lactate dehydrogenase (LD), are converted to pyruvate and NADH. The rate at which NADH is formed is determined by an increase in absorbance and is directly proportional to enzyme

activity.(Package insert: Roche LDHI2, Indianapolis, IN, May, 2015)

Isoenzyme Electrophoresis:

The 5 isoenzymes of LD are separated by electrophoresis on agarose film. The serum samples are electrophoresed and separated LD isoenzymes are visualized using a specific chromogenic substrate. The amount of resulting formazan precipitate is proportional to the LD enzymatic activity. Densitometry is used to obtain relative quantification of each fraction. The fractions are numbered according to their electrophoretic mobility, LD-I being the most mobile.(Clinical Guide to Laboratory Tests. Third edition. Edited by NW Tietz, Philadelphia, WB Saunders Company,1995; Package insert: Sebia Hydragel ISO-LDH, Sebia, Norcross, GA, July 2019)

PDF Report

No

Day(s) Performed

LD: Monday through Sunday; Continuously

LD isoenzymes: Monday, Wednesday, Friday; 10 a.m.

Report Available

1 to 4 days

Specimen Retention Time

1 week

Performing Laboratory Location

Rochester

Fees & Codes**Fees**

- Authorized users can sign in to [Test Prices](#) for detailed fee information.
- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
- Prospective clients should contact their Regional Manager. For assistance, contact [Customer Service](#).

Test Classification

This test has been cleared, approved, or is exempt by the US Food and Drug Administration and is used per manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information

83615-LD

83625-LD isoenzymes

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
LD_I	Lactate Dehydrogenase Isoenzymes, S	42929-0

Result ID	Test Result Name	Result LOINC® Value
LD	Lactate Dehydrogenase (LD), S	14804-9
305	LD Isoenzymes, S	49279-3
3344	Total LD Activity	14804-9
2282	I, Heart	2536-1
2283	II	2539-5
2285	III	2542-9
2286	IV	2545-2
2287	V, Liver	2548-6