

Background: Aminoacyl-tRNA synthetases are a group of 20 enzymes to catalyze the reaction of amino acids with t-RNA. Jo-1 antigen resides on the enzyme histidyl-tRNA synthetases and is located in the cytoplasma.

Jo-1 antibodies account for 75% of all antibodies directed against synthetases and Jo-1 antibodies occur in 20%-35% of patients with inflammatory myositis, dermatomyositis, polymyositis, in overlap syndromes, and cancer associated myositis, as well as in fibrosing alveolitis.

Sampling: 1 mL serum

Reference Interval: Negative: < 20 U/mL

Kalium Serum or Plasma see Potassium, Serum, Plasma

Kalium, Urine see Potassium, Urine

Knee Punctate see Synovial Fluid Analysis

K-L

Lactic Acid, Whole Blood, Plasma or CSF

Related Information: Ammonia, Plasma
Ethanol, Blood, Serum or Urine
Ibuprofen, Serum
Salicylate, Serum or Plasma

Synonyms: Blood Lactate, Lactate

Background: Derived from pyruvate in glycolysis, levels rise sharply during exercises. Lowest values occur during fasting and upper values during postprandial state.

Increased in lactic acidosis caused by carbon monoxide intoxication, anemia, methemoglobinemia, respiratory failure, shock hypotension.

Increased in drug mediated lactic acidosis by ethanol, methanol, ethylene glycol, cyanide, nitroprusside, salicylate, nalidixic acid, catecholamines. Increased during therapy with biguanides (phenformin), particularly in patients >60 years.

Increased in inborn errors of metabolism such as diabetes mellitus; mitochondrial myopathy; glycogen storage diseases Type I,II,III,V,VIII; fructose1-6-biphosphatase deficiency; deficiency of pyruvate carboxylation.

Increased in liver and renal failure, infections, malignancies.

Useful as a prognostic parameter for mortality and admission to the emergency unit: Patients with values >36 mg/dL need emergency care.

Sampling: 2 mL sodium fluoride plasma. For most precise results, arterial blood is required. Separate plasma immediately and transport to the laboratory soon. Temperature independent increase per hour in sodium fluoride stabilized plasma probe is 1.8 mg/dL.

Reference Interval: (mg/dL)

Neonates (capillary blood)	2.4-20
Plasma, Venous	4.5-20
Arterial	4.5-14
Plasma, CSF	11-19

Lactate Dehydrogenase (LDH), Serum

Related Information: Alanine Aminotransferase (ALT), Serum
 Aspartate Aminotransferase (AST), Serum
 Creatine Kinase (CK, NAC-activated)
 Hepatitis B (HBV), Serology and Antigen Detection
 Hepatitis B Virus DNA Detection (HBV-DNA)
 Hepatitis C Antibody (Anti-HCV)
 Hepatitis C Genotyping
 Hepatitis C Virus RNA Quantification (HCV-RNA)
 Lactate Dehydrogenase Isoenzymes, Serum
 Myoglobin, Blood or Serum or Plasma

Background: LDH is a zinc containing enzyme of the glycolytic pathway and is present in the cytoplasm of all cells. LDH is a tetramer of two active subunits, H (heart) and M (muscle), MW 134 kDa. Combination of the subunits produces 5 isoenzymes LDH 1 (HHHH) to LDH 5 (MMMM). The activity of LDH in various tissues varies only about 1.5 fold. In plasma, most LDH comes from breakdown of erythrocytes and platelets.

Percentage of Isoenzymes in tissues:

	LDH1 (HHHH)	LDH2 (HHHM)	LDH3 (HHMM)	LDH4 (HMMM)	LDH5 (MMMM)
Serum	25	35	20	15	5
Heart	45	40	10	5	0
Red Cells	40	35	15	10	0
Lung	10	15	40	30	5
Skeletal muscle	0	0	10	30	60
Liver	0	5	10	15	70

Causes for elevated levels:

A wide variety of neoplasms, particularly LDH5 elevation, combined with elevated with serum alkaline phosphatase.

Hypoxia with cardiorespiratory disease: Cardiac failure, myocarditis. After myocardial infarction, LDH starts to rise after 12h and stays elevated during 1-2 weeks. In contrast during pericarditis

and angina, LDH is not substantially elevated.

Elevated levels occur in hemolytic anemia; in megaloblastic anemias, such as pernicious anemia; in infectious mononucleosis (LDH is more elevated than AST); in inflammatory diseases; in hypothyroidism.

Pancreatitis: LDH to AST ratio > 18 in patients with biliary pancreatitis may indicate pancreatic necrosis.

Raised levels in pulmonary infarct and in lung diseases.

Viral Hepatitis: AST and ALT are more increased than LDH and LDH5 is high. Usually only moderate increase in liver disease and cirrhosis.

Elevated in renal infarct, seizures, CNS diseases, pancreatitis, collagen diseases, fractures and traumas with excessive cell death, muscular dystrophy, shock, hypotension,

Not useful in screening for cancer but selectively in Hodgkin and non Hodgkin lymphomas used as an additional staging marker.

Sampling: 1 mL of serum or plasma. Avoid any, even little hemolysis! Heparin or oxalate plasma is not accepted. Stable 3 days room temperature

Reference Interval:	Adult	135 – 220 U/L
	Newborn 4–20 days	225 – 600 U/L
	Children 2–15 years	120 – 300 U/L

Lactate Dehydrogenase Isoenzymes, Serum

Related Information:	Alanine Aminotransferase (ALT), Serum
	Aspartate Aminotransferase (AST), Serum
	Creatine Kinase (CK, NAC-activated)
	Epstein Barr Virus (EBV), Serology
	Hepatitis B (HBV), Serology and Antigen Detection
	Hepatitis B Virus DNA Detection (HBV-DNA)
	Hepatitis C Antibody (Anti-HCV)
	Hepatitis C Genotyping
	Hepatitis C Virus RNA Quantification (HCV-RNA)
	Lactate Dehydrogenase Isoenzymes, Serum
	Myoglobin, Blood or Serum or Plasma

Background: See also Lactate Dehydrogenase (LDH), Serum

The troponins have replaced LDH isoenzyme tests in the diagnosis of myocardial infarction, but LDH is useful in combination with the troponins and in the evaluation of other disease.

LDH1 may be a marker in testicular seminoma resp. in dysgerminoma, but there is also a relation to nonseminomatous tumors.

Sampling: 1 mL of serum or plasma. Avoid any, even little hemolysis! Heparin or oxalate plasma is not accepted. Stable 3 days room temperature

Reference Interval:	main origin	
LDH 1:	20–33%	red blood cells, heart
LDH 2:	21–40%	red blood cells, heart
LDH 3:	16–32%	
LDH 4:	5–13%	liver, skeletal muscle
LDH 5:	3–9%	liver, skeletal muscle

LDH1 to LDH2 ratio normally 0.5-0.8, in myocardial damage and in hemolytic anemias LDH1 becomes greater than LDH2.

Lactate, Liquor see Cerebrospinal Fluid (CSF, Liquor)

Lamotrigine, Serum

Synonyms: Lamictal[®]

Background: As phenytoin, lamotrigine suppresses rapid firing of neurons and inactivates sodium channels. It is used in focal epilepsy and primary and secondary generalized tonic clonic seizures. It is efficient in myoclonic seizures, absences, atonic and tonic seizures, and in Lennox-Gastaut syndrome.

Adverse effects are headache, diplopia, nausea, somnolence and rash. Life threatening dermatitis develops in 1%-2% of pediatric patients.

Bioavailability 93%-100%; urinary excretion 10%; plasma binding 56%; volume of distribution 0.9-1.2 L/kg; half life time 24-35h increased in liver disease and severe renal disease; peak time 1-3.4h, peak concentration 2.1-2.9 µg/mL after a single 200 mg oral dose.

Lamotrigine undergoes glucuronidation to 2-N-glucuronide as the primary elimination pathway. Valprionate increases half life twofold.

Sampling: 2 mL serum

Reference Interval: Therapeutic 2.0-10 µg/mL

Legionella Pneumophila

Background: Legionellae are gram negative rods, staining faintly and requiring a highly enriched iron and cysteine medium for culture. Approx 90% of pneumonias caused by legionellae are due to *L. pneumophila*, 9% to *L. micdadei* and *L. bozemanii*, 1% to the other approx. 30 species.

Main source for infection is environmental water in air conditioners and water tapes. Airborne transmission does not occur. Immunocompromised patients are on high risk for acquiring Legionella infection. Legionellae account for 5%-15% of adults and 1% of children's pneumonia. Named after the outbreak of pneumonia during a convention of the American Legion in Philadelphia in 1976, Legionellae causes atypical pneumonia (also atypical: Mycoplasma, viral, psit-

tacosis, Q fever). Incubation period is 2-14 days. Clinically mild forms are characterized by pneumonias accompanied by influenza like illness (Pontiac Fever), severe forms by non-bloody diarrhea, proteinuria, and hematuria.

Laboratory Diagnosis: Sputum gram stain usually is negative for bacteria. Culture needs a special supplemented media, the laboratory should be notified if an atypical pneumonia is expected.

Legionella antigen may be detected in lung tissue and in the urine.

Raise in antibody titer in convalescent serum 2 weeks apart is a reliable test for Legionella infection.

Treatment: Erythromycin in combination with rifampicin. Alternative: Levofloxacin or moxifloxacin

Sampling: Serology: 2 mL serum each at the beginning and after 3-8 weeks.

Culture: Sputum, bronchial lavage, tracheal secret, blood.

For environmental screening: 200 mL water

Reference Interval: Serology: Antibody titer negative < 1:100

Culture: Report on diagnostic finding: Growth of Legionellae

Leishmaniasis, Serology

Related information: Chagas Disease and Protein Electrophoresis, Serum

Test includes: *L. donovani*

Background: The four major pathogens of the genus *Leishmania* are *L. donovani*, *L. tropica*, *L. mexicana*, *L. brasiliensis*. Other species are *L. major*, *L. aethiopica*, *L. peruviana*.

L. donovani causes kala-azar or visceral leishmaniasis. The life cycle involves the sand fly species *Phlebotomus* in the old world and *Lutzomyia* in S. America. Dogs and rodents, foxes are reservoirs. The sandfly ingests macrophages from an infected host containing amastigotes, differentiating into promastigotes within 10 days in the gut, multiplying and are transmitted during the next bite. Affected organs are part of the reticuloendothelial system (liver, spleen, bone marrow) resulting in normocytic normochromic anemia, leukopenia, polyclonal gammopathy and thrombocytopenia. Symptoms are intermittent fever, weakness weight loss, enlarged spleen, gastrointestinal bleedings which are persisting for month to years.

Treatment: Sodium stibogluconate.

Leishmania tropica, *L. mexicana*, *L. brasiliensis*: *L. tropica* and *L. mexicana* cause the cutaneous form of leishmaniasis. *L. brasiliensis* is the cause of a mucocutaneous form. Endemic in Central and South America.

Clinically the initial cutaneous lesions is a red papule at the bite site, enlarging and forming satellite nodules that ulcerate. In immunocompetent patients a single lesion heals spontaneously.

In the mucocutaneous form metastatic lesions are formed frequently developing disfiguring granulomatous ulcerating lesions at the nasal cartilage, with a slow healing tendency.

Limitations: Serology is helpful in epidemiology studies, for clinical diagnosis serology is of limited help. Cross reaction with Chagas disease and malaria.

Sampling: 1 mL serum

Reference Interval: Antibody detection: negative

Leptospira, Serology

Related information: Leptospira Culture, Blood or Urine or Liquor

Background: Please see Leptospira Culture, Blood or Urine or CSF.

Human leptospirosis is usually caused by *L. interrogans* with approx. 200 serologic variants.

Sampling: 1 mL serum. Acute and convalescent sera drawn 2 weeks apart.

Reference Interval: Test includes *Leptospira interrogans* serovar autumnalis, -australis, -canicola, -hebdomalis, -icterohemorrhagica

A single titer is of very limited value, titer < 1:160 are considered as negative.

A four fold increase in titer in paired samples is positive.

Peak of antibody titer at week 3 to 6, slow decline afterwards.

Leptospira Culture, Blood or Urine or Liquor

Related Information: Leptospira, Serology

Background: Three genera of spirochetes cause human infections: *Treponema*, *Borrelia*, and *Leptospira*. *Leptospira* are fine, spirale shaped bacteria, which are not stained with dyes but are seen by dark field microscopy and can be cultured in rabbit serum or albumin with fatty acids containing media. *Leptospira* species. infects rats and other rodents, domestic livestock and dogs. Animals excrete the bacterium in urine. *Leptospira* infection is acquired by contact with contaminated mud, freshwater or soil through ingestion, entry through mucous membranes, conjunctiva or broken skin, putting miners, farmers, veterinarians, dairymen, swineherds, abattoir workers, miners, fish and poultry processors, outdoor adventures (canoeing, rafting, swimming), on risk. Person to person transmission is rare.

The disease is typically biphasic with fever, chills, headache, and aseptic meningitis first and followed by a short period of resolution. A second phase is characterized by aseptic meningitis, liver dysfunction and impaired kidney function. Clinically leptospirosis can vary from a mild, self limiting disease to fulminant, fatal hepatorenal failure (Weil syndrome).

Sampling: Avoid for bacterial culture of urine contamination with skin flora. Best to use is the mid portion of the urine stream (avoid first and final portion), catheter or suprabubic puncture urine. Blood or cerebrospinal fluid is suitable, too. The first septicemic phase lasts from day 4 to 7 post infection, when cultural results may be positive. Within the followed 1-3 days, culture is negative. During the last phase and up to several months, low numbers of leptospira are intermittent released in the urine. Frequent sampling is necessary.

Avoid blood collection in citrate solutions. Transport specimen into the laboratory within one hour. Do not refrigerate.

Report on diagnostic findings: No *Leptospira* species isolated
Incubation time 4-6 weeks.

Leucine Aminopeptidase (LAP), Serum

Related Information: Alkaline Phosphatase, Serum
 Bilirubin, Fractionated, Serum
 Gamma-Glutamyl Transferase (Gamma-GT), Serum

Synonyms: Arylamidase; Arylamidase-Naphthylamidase; LAP

Background: LAP is present in all tissues; it hydrolyzes amino acids from the terminal end of peptides, with highest activity at leucine terminal sites. In serum most of LAP is of liver origin where it is membrane bound similar to GGT and ALP.

Used to differentiate in patients with increased alkaline phosphatase levels between liver and biliary tract (increased) versus bone diseases (no increase). Increased in cholestasis.

May be useful to detect early renal tubular injuries in diabetes mellitus patients.

Increased in the third trimester of pregnancy, produced by the placenta.

In the majority of patients with systemic lupus erythematosus LAP is increased.

Elevated levels, even without liver metastases, occur in malignancies such as breast, endometrial and ovarian carcinomas, in germ cell tumors of ovary and testis.

Sampling: 1 mL serum (EDTA -, Oxalate-, Citrate-, plasma not accepted)

Reference Interval:

Male	19-35 U/L
Female	18-33 U/L

K-L

Light Chain see Free Light Chains Structure (FLC), Serum

see Free Light Chains Structure, Urine

Lipase, Serum

Related Information: Amylase, Total, Serum
 Amylase, Total, Urine
 Bilirubin, Fractionated, Serum

Synonyms: Triacylglycerol Acylhydrolase

Background: Pancreatic lipase is a glycoprotein with a molecular weight of 45 kDa. It hydrolyzes glycerol esters of long fatty acid chains at the 1 and 3 ester bonds. Lack of bile salts with a lack of emulsification and absence of co-lipase renders lipase activity ineffective.

Pancreatic lipase activity is sensitive marker in the evaluation of pancreatitis. In contrast to amylase it does not occur in saliva and lipase returns to normal later than amylase.

Lipase may be elevated in patients with obstruction of the pancreatic duct, in renal diseases acute cholecystitis, intestinal obstruction or infarction, duodenal ulcer, liver diseases, alcoholism, diabetic ketoacidosis. Patients with abdominal trauma have elevated amylase and lipase levels; in patients with mumps elevated lipase indicates an involvement of the pancreas.

Drugs capable to increase serum lipase are: acetaminophen, valproic acid, oral contraceptives, codeine, meperidine, methacholine, morphine, pentazocine, secretin, calcitriol, cerivastatin,

chlorothiazide, clozapine, diazoxide, didanosine, dideoxyinosine, estropipate, felbamate, hydrocortisone, mercaptopurine, metolazone, metronidazole minocycline, nitrofurantoin, pegaspargase, prednisolone, sulfamethoxazole.

Sampling: 1 mL serum (EDTA plasma not accepted), stable for 1 week at room temperature.

Reference Interval: < 60 U/L

Lipoprotein (a), Serum

Related Information: Apolipoprotein A I and B-100, Serum
Low Density Lipoprotein Cholesterol

Synonyms: Lp(a)

Background: Lp(a) has been shown in studies to be a risk factor for coronary heart disease and cerebrovascular diseases. However, other studies failed to demonstrate the correlation. There is a wide range for values across populations. For individuals of African origin the median values are three times higher than the median in whites. Reference intervals have to be adjusted to ethnic group the patient belongs to.

Sampling: 1ml serum, stable for one week refrigerated.

Reference Interval: MEDLAB suggests for the German white population a cut off at 30 mg/dL

Liquiprin® see Acetaminophen, Serum

Liquor see Cerebrospinal Fluid (CSF, Liquor)

Listeria monocytogenes, Serology

Background: *Listeria monocytogenes* is a short, motile, Gram-positive, non-spore-forming bacillus causing gastroenteritis, invasive infections particularly in immunocompromised and elderly patients. In sheep and cattle it is associated with encephalitis and abortion. *Listeria monocytogenes* is widespread in natural environment particularly in soil, decayed matter, wood. Human cases are due to ingestion of contaminated food such as inadequate pasteurized dairy products and contaminated processed meats. Incidences in Europe and US are 0.7 cases per 100 000 population, mortality 40%, neonatal incidences in the US and Europe are 13 per 100 000 live birth.

Listeriosis during pregnancy is characterized by influenza like illness with fever and chills, fatigue, muscle pain headache and often precedes delivery by 2-14 days. Premature labor is common, 70% deliver newborns at less than 35 weeks of gestation. Mortality including stillbirth and abortion rate of 40%-50%. In neonates there is an early (within 2 days of life) and a late onset form after 7 days of life. The late onset form presents in 95% with meningitis, whereas the early on-

set form presents with pneumonia (60%), cyanosis, apnea, respiratory distress, anemia (62%), thrombocytopenia (35%) and meningitis (21%). Isolation rates from blood is 73% in early onset cases, from CSF 94% in late onset cases.

Sampling: 1 mL serum

Reference Interval:

Differentiation of immunoglobulin class		
IgG antibody	negative:	< 1:1000
IgM antibody	negative:	< 1:1000

Liver Kidney Microsomal Antibodies (LKM Antibodies)

Related Information:

- Antimitochondrial Antibodies
- Antinuclear Antibody
- Bilirubin, Fractionated, Serum
- Smooth Muscle Antibodies
- Soluble Liver Antigen (SLA)-Antibody (Anti-SLA)
- Thyroglobulin Antibody
- Thyroperoxidase Autoantibody

Background: LKM antibodies bind to three microsomal proteins:

- LKM-1: LKM -1 bind predominantly to the cytochrome P450 2D6 (MW 50kD). LKM-1 antibodies are characteristic for autoimmune hepatitis type 2. Two subsets are known:
 - The subset type 2a is characterized in addition to by the presence of anti-liver cytosol 1 antibodies. Types 2a patients are mainly HCV negative, female children with higher levels of LKM-1.
 - The type 2b subset patients are positive for HCV but less often positive for LKM-1.
- Limitation: In 2% of patients with viral hepatitis C LKM-1 antibodies are present. LKM-1 antibodies may be present in thyroiditis, diabetes mellitus, hemolytic anemia, arthritis, and colitis ulcerosa.
- LKM-2: In Drug induces hepatitis (by Ticrynafen) LKM-2 may be elevated.
- LKM-3: Antibodies are present in 10%-20% of the chronic hepatitis D patients
 - For classification of autoimmune hepatitis please also see Soluble Liver Antigen (SLA)-Antibody (Anti-SLA)

Sampling: 1 mL serum

Reference Interval: Negative

K-L

Low Density Lipoprotein Cholesterol

Related Information:

- Apolipoprotein A-1 and B100, Serum
- Cholesterol, Total, Serum or Plasma
- High Density Lipoprotein Cholesterol, Serum or Plasma
- Triglycerides, Plasma or Serum

Synonyms: Beta Lipoproteins, LDL Cholesterol, LDLC

Background: LDLC concentration is considered a major risk factor for coronary artery disease.

Limitations: LDLC may be increased by thiazides, beta blockers, and estrogens; decreased by fish oils, niacin, and fibrates.

Sampling: 1 mL serum (no EDTA plasma)

To obtain best results patients should be on a stable diet for 3 weeks and fasting for 10 h before sample drawing.

Reference Interval:	Optimal	less than 100 mg/dL
	Good	100-129 mg/dL
	Borderline	130-159 mg/dL
	Elevated	160-189 mg/dL
	Very high	above 190 mg/dL

Lupus Anticoagulants / Lupus Inhibitors, Serum or Plasma

Related Information: Activated Partial Thromboplastin Time
Cardiolipin Antibody
HIV Type 1 and Type 2, Serology
Platelet Count
Treponema pallidum (TPAH Serology)

Background: Lupus anticoagulants (LA) and anticardiolipin antibodies (ACA) are antiphospholipid antibodies. LA are mainly IgG and IgM class immunoglobulins forming complexes with prothrombin and beta-2 glycoprotein-I, which subsequently react with phospholipids of the clotting system.

Clinically, LA is highly correlated with venous and arterial thrombosis, and to a lesser extent with thrombocytopenia, systemic lupus erythematoses, abortion and other autoimmune diseases. LA or ACA may be associated with drugs such as procainamide, phenytoin, chlorpromazine as well as with infections (EBV, varicella, malaria, tuberculosis, borreliosis, HIV), with malignancies and with Sneddon syndrome, Guillain Barre and Behçet-syndrome.

Limitations: 5% of the healthy population has low titers of LA or ACA, increasing with age.

Sampling: 3 mL citrate plasma, snap-freeze immediately, ship frozen. Avoid traumatizing the vessel during puncture, the vessel membranes and thrombocytes contain neutralizing phospholipids. High concentration of heparin may give false positive results.

Reference Interval: Negative: 14–40 seconds

Luteinizing Hormone (LH)

Related Information: Estradiol, Serum
Follicle Stimulating Hormone (FSH), Serum
Progesterone, Serum
Prolactin, Serum
Testosterone, Serum

Synonyms: Follitropin, ICSH, LH

Background: The decapeptide, with carbohydrate side chains, gonadotropin releasing hormone (GnRH) secreted by the hypothalamus stimulates release of Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) from the pituitary gland. The alpha subunit of the glucocorticoids (TSH, hCG, LH, FSH) are nearly identical, the beta subunit confers hormone specificity. In children, both gonadotropins are constant and low, FSH is higher than LH. Both hormones increase in puberty, LH increase first during non REM sleep, later in puberty sleep and wake pattern are equivalent.

In men LH and FSH pattern is pulsatile, LH with 9-14 secretory surges per day with 2-3 fold increases, FSH with low magnitudes of 25% increases over mean.

In women the menstrual cycle is divided in a follicular phase and a luteal phase by the midcycle peak of LH and FSH. FSH and LH are higher in the follicular phase than during the luteal phase, FSH in addition is falling during the preovulatory period.

In postmenopausal women, gonadotropins are secreted in a more episodic fashion. FSH levels are higher due to lack of granulosa cell produced inhibin. This negative feed back mechanism for FSH is not affected by administration of estrogens. LH levels are similar or higher.

In men there is an increase in LH and FSH, in part due to lack of negative feed back by decreased testosterone.

Diagnostic use: Elevated FSH and LH values occur in anorchia, gonadal failure, testicular feminization syndrome and in menopause.

Low serum levels occur in primary pituitary or hypothalamic failure.

High LH, a LH to FSH ratio > 2 , increased ovarian androgens, and non ovulatory rhythm has a 75% diagnostic sensitivity for Stein-Leventhal Syndrome. High LH during the follicular phase in polycystic ovary syndrome may interfere with conception.

Limitations: LH secretion is pulsatile and can vary by 60% from the daily mean in the course of the day, whereas FSH can vary by 20%.

Sampling: Serum: 1 mL serum. To obtain highly reliable results, up 6 samples during a six hour period are recommended. LH in serum is stable 2 weeks at room temperature.

Urine: 24h urine, collect in a container prefilled with boric acid. Urine collection over a 24h period LH minimizes pulsatility error. The LH serum ovulatory peak occurs 24h-36h delayed in urine.

Reference Range:

		Serum	Urine
Female:	follicular phase	2.0–16.0 IU/L	< 5 IU/24h
	ovulatory peak	20.0–60.0 IU/L	
	luteal phase	2.0–16.0 IU/L	< 5 IU/24h
	menopausal	20.0–60.0 IU/L	> 5 IU/24h
Male:	< 70 years	1.0–6.0 IU/L	< 0.2-5 IU/24h
	> 70 years	3.1–35.0 IU/L	
Children:	prepubertal	0.5–4.0 IU/L	< 0.2 IU/24h

Lyme Disease see *Borrelia*, Serology

Lymphocyte Immunophenotyping

Related Information: Beta-2-Microglobulin, Serum or Urine
Complete Blood Count
HIV Type 1 and 2, Serology

Background: Mature T cells (CD3⁺) express either CD4 or CD8 antigen, defining T helper cells as CD4⁺ and suppressor/cytotoxic as CD8⁺ cells.

General imbalances of the immune system occur in Fas deficiency. Fas is a surface marker (CD95, of group TNF) normally interacting with Fas-L leading to apoptosis. Fas deficiency leads to a non malignant proliferation of CD4⁺ CD8⁻ T-cells known as autoimmune lymphoproliferative syndrome (ALPS) or Canale Smith syndrome.

Enumeration is useful in monitoring HIV positive patients. CD4⁺ cell number usually fall by 30%, CD8⁺ increase by 40% during 6-12 month after infection and the ratio CD4⁺ / CD8⁺ falls below 1. Absolute CD4⁺ count falling below 400 cells/ μ L indicates disease progression.

CD8⁺ T-cell count also increase during other viral infections and after vaccination, therefore absolute numbers are useful to determine.

Splenectomy increases absolute lymphocyte count.

Idiopathic CD4⁺ lymphocytopenia (ICL) is a rare cause of low CD4⁺ count and is often associated with a decreased CD8⁺, NK and B-cells count.

Limitations: Abnormal values are reported from patients under steroid therapy, immunosuppressive therapy, recent surgery with general anesthesia, and in patients with lymphomas.

Asian population display a lower mean percentage of CD4 values, a lower ratio, and a lower absolute CD4 lymphocyte count.

Sampling: 3 mL EDTA blood. Sample is stable for 24h at room temperature, do not refrigerate, do not freeze

Reference Interval:	percent	absolute
T-lymphocytes		
T-lymphocytes, total	75–93%	800-2500/ μ L
T-helper lymphocytes (CD4 ⁺)	35–60%	650-1200/ μ L
T-suppressor lymphocytes (CD8 ⁺)	30–38%	500-800/ μ L
B-lymphocytes		
B-lymphocyte count, total	7–17%	70-350/ μ L
Natural killer cells (NK)	5–15%	50-300/ μ L
Ratio CD4 ⁺ /CD8 ⁺	1.1–2.3%	

Lymphocin® see Vancomycin, Serum

Lysozyme, Blood or Urine or CSF

Synonyms: Muramidase

Background: Lysozyme is present in neutrophil granules, in leukemic and normal eosinophils. The test is used in the differentiation of leukemia. Lysozyme is present in the M4 type of acute myeloid leukemia, occasionally in the M1, M2, and M6 type. It has been found to correlate with the degree of differentiation of monocytes in leukemia.

Also used as a marker in monitoring sarcoidosis, and it may be elevated in tuberculosis.

Sampling: Serum: 1 mL, separate serum or plasma and freeze immediately.

Urine: 5 mL aliquot of a 24h collected urine shipped frozen and collected on ice.

A random urine sample is suitable, too.

CSF (Cerebrospinal fluid): 0.5 mL

Reference Interval:

Serum:	4-15.6 µg/mL
Urine:	0-1.4µg/mL
CSF:	< 1.5 µg/mL

M2 – PK, Feces

Related Information: CA 19-9, Serum (Gastrointestinal)

Background: M2-PK is an isoenzyme of pyruvate kinase (PK), expressed in proliferating and in tumor cells. PK occurs in a tetrameric form and in a dimeric form. In tumor cells, the dimeric form (tumor M2-PK) is predominant. Since tumors of the gastrointestinal tract grow into the lumen, tumor M2-PK is detectable in the feces of patients with GI malignancies.

Colorectal cancer: Sensitivity for detection of colorectal cancer or polyps was shown to be 27% and 10% for the occult blood (Guajak), 91% and 19% for the immunological test for occult blood and 73%-77% and 48% for the M2-PK-test, respectively. Specificity was 89%, 94% and 72%, respectively, indicating that M2-PK display a lower specificity in diagnosing cancer.

TNM and Dukes' classification of the tumors correlates strongly with faecale M2-PK levels.

Gastric cancer: Compared to controls, samples of patients with inflammatory bowel disease or different types of gastrointestinal tumors did not show significant differences, but up to 80% of patients with gastric cancer present elevated M2-PK.

Sampling: approx. 2 g stool

Reference Interval: < 4 U/mL

Magnesium (Mg), Serum

Related Information:

- Calcium (Ca), Total, Serum or Urine
- Digoxin, Serum
- Magnesium, Urine
- Potassium, Urine
- Vancomycin, Serum