Gamma-Glutamyl Transferase (Gamma-GT), Serum a

Related Information: Alanine Aminotransferase (ALT), Serum
Alkine Phosphatase, Serum
Aspartate Aminotransferase (AST), Serum
Bilirubin, Fractionated, Serum
Leucine Aminopeptidase (LAP), Serum

Synonyms: Gamma Glutamyl Transpeptidase; GGT; GGTP;
Glutamyl Transpeptidase; GT; GTP

Background: The enzyme, excreted by the biliary system, it is a sensitive indicator for obstructive hepatobiliary diseases such as intrahepatic cholestasis, hepatitis or pancreatitis. It is more specific for the hepato-biliary tract than alkaline phosphatase and independent from bone diseases or pregnancy whereas alkaline phosphatase is. It is independent from age beyond infancy. GGT values are independent also, in contrast to aspartate aminotransferase, from skeletal muscle diseases. Renal function does not influence GGT levels.

GGT is more sensitive to obstructive diseases than aspartate aminotransferase (AST) or alanine aminotransferase (ALT). Increase of GGT in obstructive diseases is about 5 - 50 times, in infectious hepatitis no more than 5 times.

Used in the diagnosis and monitoring treatment of hepatomas, carcinomas of the pancreas and in liver metastasis. There is a good correlation with tumor progression.

In the diagnosis of chronic alcohol liver diseases a 2-fold increase above normal levels and an AST:ALT ratio > 2:1 suggests ethanol abuse.

GGT correlates with body mass index,

Moderate increased in infectious mononucleoses and in systemic lupus erythematosus. Very high concentrations are found in primary biliary cirrhosis and in infants with biliary atresia. Increased in hyperthyroidism, decreased in hypothyroidism.

Drugs: Decrease: azathioprine clofibrate, estrogens, methotrexate, ursodiol.

Increase: acetaminophen, aminoglutethimide, phenytoin, barbiturates, carbamazepine, diphenylhydantoin, estrogens, interferon alpha, medroxyprogesterone, contraceptives, phenothiazine, valproic acid.

Sampling: 1 mL serum, EDTA or heparin plasma. Avoid hemolysis. Fasting sample is optimal.

Reference Interval:

	Male:	< 66 U/L
	Female:	< 39 U/L
	Children:	< 45 U/L

Higher in newborns 3 - 6 month of age

Gastrin, Serum f

Related Information: Helicobacter Pylori
Vitamin B 12, Plasma or Serum

Background: Gastrin a polypeptide hormone is secreted by neuroendocrine G cells of the gastric antrum and primary acts as an acid secretagogue and it is tropic for histamine secreting enterochromaffin cells of the gastric mucosa and weakly stimulates the secretion of pancreatic enzymes and gallbladder contractions.

Useful in the diagnosis of gastrin secreting carcinoid tumors, most commonly (90%) located in the duodenum or pancreas or peripancreatic lymph nodes and are associated with the Zollinger Ellison syndrome (ZES) and with chronic atrophic gastritis.

A diagnosis of ZES can be made on low fasting gastric ph < 2.5 and high fasting gastrin values > 1000 ng/L. A secretin test can be applied in patients not fulfilling theses criteria. In healthy persons, secretin application decreases serum gastrin levels, in patients with gastrinomas levels raise > 200 ng/L.

Limitation: Gastrin cell hyperplasia is also characterized by elevated gastrin values and gastric hyperacidity. Gastrin is also elevated in atrophic gastritis, pernicious anemia, retained antrum, after surgical small bowl resection, renal failure and cirrhosis.

Sampling: 2 mL serum or 2 mL EDTA plasma, (no heparin !), separate in refrigerated centrifuge soon and transport to laboratory at 4°C within 4h or freeze at -20°C and ship frozen. Therapy with proton pump inhibitors should be interrupted. To obtain basal levels, a 12 h (overnight) fasting period is required.

For secretin stimulating test: Stimulate with an injection of 2 units/kg body weight of porcine secretin and obtain samples before stimulation, at 2 min, 5 min, 10 min, 15 min, 20 min and 30 min.

Reference Interval: Fasting sample:

Newborn 0 - 4 days	120 - 183 ng/L
Children	10 - 125 ng/L
15 - 60 years	25 - 90 ng/L
> 60 years	< 100 ng/L

Values > 500 ng/L indicate a significant elevation.

Gentamycin, Serum f

Related Information: Creatinine Clearance
Creatinine, Serum or Plasma
Creatinine, Urine

Synonyms: Refobacin®

Background: Gentamycin, an aminoglycoside antibiotic, is a bactericidal, concentration dependent protein synthesis inhibitor, used in treatment of aerobic gram negative bacteria.

Good activity in Pseudomonas aeruginosa, methicillin sensitive Staphylococci, Enterobacter aerogenes, Klebsiella pneumoniae, E.coli, Proteus vulgaris, Serratia sp., Yersinia sp., Pasteurella

sp, Brucella sp, Campylobacter fetus.
Moderate activity against Gonococci sp., Listeria sp, Haemophilus influenza, Proteus mirabilis, Salmonella sp.
Half life time: newborns: 5 h; Children and adults: 1.5 - 2 h. No protein binding.
Indicated in urinary tract infections, in pneumonias, meningitis, peritonitis.
Aminoglycosides are excreted nearly entirely by glomerular filtration and dose has to be adjusted to renal function:

creatinine clearance mL/min	% of maximum daily dose (5.5 mg/kg body weight)	frequency
100	100	every 24 h
75	75	every 24 h
50	50	every 24 h
25	25	every 24 h
20	80	every 48 h
10	60	every 48 h
< 10	40	every 48 h

Sampling: 2 mL serum.
Reference Interval: Therapeutic values: 4.0 – 10.0 µg/mL
Toxic values may start at: > 12.0 µg/mL

Germanium (Ge), Serum f

Background: Low concentrations of the non-essential trace element germanium occur in nearly all soils, plants and animal life.
General toxicity to men of germanium is low (except for the tetrahydride germane).
However, low numbers of human cases linked to prolonged intake of germanium products with renal failure and even death have been reported, characterized by kidney dysfunction, kidney tubular degeneration, and germanium accumulation as well as other adverse effects such as anemia, muscle weakness, and peripheral neuropathy. Recovery of renal function is slow and incomplete even long after withdraw from germanium. The total dose of ingested germanium (as dioxide, carboxyethyl, germanium sesquioxide, germanium-lactate-citrate, or others) to reach toxicity is reported to be 15 g-300 g over 2 month to 3 years.
High doses of germanium may result in an increased embryonic resorption, but possible malformations have been reported only after administration of dimethyl germanium oxide to pregnant animals.
Germanium is seems not to be carcinogenic and even appears to inhibit cancer.
Germanium oxide has been shown to be effective in vitro for inhibiting effects of mutagenic substances.
Possible anticancer effects of the organogermanium compound bis (2-carboxyethylgermanium) sesquioxide, which is not naturally occurring, may be due to induction of interferon-gamma, the

enhancement of natural killer cell activity, and inhibition of tumor and metastatic growth.
In patients with premenstrual syndrome lower levels of the toxic metals lead, arsenic, and germanium were found to be significantly elevated (lowered levels of calcium, chromium, copper, and manganese).
In children with Kashin-Beck disease have lowered hair concentrations of germanium (and selenium boron).
It may be useful to monitor trace metals in patients undergoing hemodialysis. In uremic patients an important factor affecting trace element concentration is the degree of renal failure and modality of replacement. Several trace elements have been implicated in the decline of renal function including germanium, arsenic, cadmium, copper, lead and mercury. In uremic patients, aluminium, cadmium, chromium, lanthanum, strontium and zinc have been shown to accumulate in bone.
Sampling: 5 mL serum
Reference Interval: < 1.4 µg/L

Giardia lamblia, Microscopy f

Related Information: Amoeba Antibody, Serology
Amoeba direct Examination, Stool
Synonyms: Giardia intestinalis; Lamblia intestinalis
Background: G. lamblia has a two stage life cycle, the trophozoite and cyst. The trophozoite is pear shaped with two nuclei, four pairs of flagella. The cyst is oval with four nuclei.
Transmission occurs by ingestion of the cyst with contaminated water or food. After encystations in the duodenum the trophozoite does not invade the gut wall, but inflammation occurs and malabsorption develops.
The parasite occurs worldwide, outbreaks have been reported related to contaminated water, chlorination does not eradicate the cysts. Reservoirs are humans and other mammals. In male homosexuals the prevalence is increasing. Decreased gastric acid may predispose individuals to infection. Overall human infection rates vary between 5% - 15%.
Clinically giardiasis presents with anorexia, nausea, abdominal cramps, persisting for weeks. Giardiasis is one of the common causes of traveler's diarrhea. 50% of the infected individuals are asymptomatic.
Therapy: Metronidazole or quinacrine hydrochloride
Sampling: fresh stool; There is a cyclical peak every 3 - 7 days.
Reference Interval: Direct detection of Giardia by stool microscopy

Gliadin IgG/IgA Antibodies f

Related Information: Endomysial Antibodies
Immunoglobulin A

Background: In Western countries, Celiac disease or gluten-sensitive enteropathy is the major cause of sprue. Determination of IgA, and in approx. 10% of patients with IgA deficiency, of IgG antibodies to the gluten protein gliadin. Endomysial IgA antibodies and transglutinase antibodies are useful in diagnosis of celiac disease.

Clinically, sprue is characterized by diarrhea, flatus, steatorrhea, anemia, delayed puberty, impaired growth, weight loss, and osteoporosis.

There is a close association of dermatitis herpetiformis with gluten sensitive enteropathy.

The most sensitive method to diagnose celiac disease is intestinal biopsy, followed by endomysial antibodies and IgA and IgG gliadin antibody evaluation.

Sampling: 1 mL serum

Reference Interval: Differentiation of immunoglobulin class

Adults:

IgA antibody negative: < 25 RE/mL, borderline 25 - 50 RE/mL, positive > 50 RE/mL

IgG antibody negative: < 25 RE/mL, borderline 25 - 50 RE/mL, positive > 50 RE/mL

Children < 4 years:

IgA antibody negative: < 50 RE/mL, borderline 50 - 100 RE/mL, positive > 100 RE/mL

IgG antibody negative: < 50 RE/mL, borderline 50 - 100 RE/mL, positive > 100 RE/mL

Glucagon, Plasma f

Related Information: Adrenocorticotropic Hormone, ACTH, Plasma
Gastrin, Serum
Glucose, Blood, Urine, Liquor
5-Hydroxyindoleacetic Acid (5-HIAA), Quantitative, Urine
Insulin, Serum

Background: Glucagon is a polypeptide counteracting the effects of insulin. Glucagonoma, a rare neuroendocrine tumor of the pancreas, secretes glucagon levels of > 500 pg/mL, values of > 1000 pg/mL are diagnostic. Clinically the patient presents with skin rash, impaired glucose tolerance, abdominal pain, diarrhea, peptic ulcer, and anemia.

Limitations: Increased values may occur in diabetic ketoacidosis, stress, uremia, Morbus Cushing, cirrhosis, hyperosmolality, pancreatitis, large burn wounds, trauma, surgery; decreased values develop in cystic fibrosis, chronic pancreatitis, post-pancreatectomy.

Sampling: 2 mL EDTA plasma supplemented with 0.1 mL (250 - 500 units) of the protease inhibitor Trasylol, snap-freeze, and ship frozen. 12h fasting sample for basal levels.

Reference Interval: 40 -130 pg/mL

Glucose a

Related Information: Cerebrospinal Fluid (CSF, Liquor)
Glycosylated Hemoglobin A1c , Blood
Insulin, Serum
Insulin Resistance

Background: Diagnostic procedures in diabetes mellitus includes:
1) random plasma glucose
2) fasting plasma glucose
3) two hour post-glucose load glucose assays.

Gestational diabetes mellitus is in the first step screened by 1h plasma glucose post 50 g glucose load and in case of abnormal values a 100 g glucose load test is recommended.

1. Random Glucose Plasma

Background: Useful test in monitoring therapy of diabetes mellitus and one of the parameters to diagnose. Used in monitoring metabolic diseases such as ketosis, acidosis, and coma. Hypoglycemia should prompt investigation of C peptide and insulin.

Sampling: 1 mL blood in sodium fluoride tube

Reference Interval:

Newborns	< 115 mg/dL (6.4 mmol/L)
Children and Adults	< 200mg/dL (11.1 mmol/L)
Hypoglycemia:	47-60 mg/dL (2.6 - 3.3 mmol/L)
Critical:	
neonates	< 40 mg/dL (2.2 mmol/L)
adult male	< 50 mg/dL (2.8 mmol/L) or > 400 mg/dl (22.2 mmol/L)
adult female	< 40 mg/dL (2.2 mmol/L) or > 400 mg/dl (22.2 mmol/L)

2. Fasting Glucose, Plasma

Synonyms: Blood Sugar Fasting, FBS; FPS;

Background: Causes of elevated fasting blood glucose levels are:
Non-fasting specimen
Stress
Cushing disease
Acromegaly
Pheochromocytoma
Glucamoma,
Liver disease
Pancreatitis,
Drugs such as thiazides, glucocorticoids, beta-blockers, estrogens etc.

Causes of hypoglycemia:
Islet cell tumors (measure C peptide and insulin as well)

Adrenal insufficiency
Adrenal hyperplasia
Hypopituitarism
Fructose intolerance, galactosemia, leucine sensitivity
Drugs salicylates, quinine etc.
Childhood

Glycogen storage diseases, galactosemias, fructose intolerance, ketotic hypoglycemia of nfancy, fructose 1-6 diphosphatase deficiency, carnitine deficiency are causes of neonatal hypoglycemias.
Limitations: Hypoglycemia as an artifact is caused by leucocytosis, hemolysis or glycolysis in delayed non-separated specimens,

Sampling: Patient's preparation: 8h fasting prior to sampling, morning sampling preferred.
Draw 1 mL blood in sodium fluoride tube.
Glucose is decreasing by 5 - 10mg/dL (0.3 - 0.6 mmol/L) per hour if unseparated.

Reference Interval:	Premature infants as low as 30 mg/dL (1.6 mmol/L)	
	Newborns	40 - 60 mg/dL (2.2 - 3.3mmol/L)
	Children	60 - 100 mg/dL (3.3 - 5.6 mmol/L)
	Adults	65 - 110 mg/dL (3.3 - 6.0 mmol/L)

3. Post-glucose Load, Plasma

Synonyms: Oral Glucose Tolerance Test, Postprandial Glucose, PP.

Sampling:

Patient's preparation:

Patients fasting for 8h, test usually done in the morning
75 g load: Oral intake of a commercially available solution.

Gestational diabetes mellitus:

Fasting not required
50 g load: oral intake of a commercially available solution
100 g load: if the 50 g test result is equivocal or abnormal

Sampling time:

75 g: load 2 hours after glucose intake
50 g: load 1 hour after glucose intake
100 g: load fasting sample, 1 h and 2 h and 3 h after intake. Label properly

Reference Interval:

Recommendations of the American Diabetes Association (ADA):
Diagnosis of diabetes mellitus: One out of the following 3 criteria is positive and has been confirmed by any of the following on a subsequent day
- Symptoms of diabetes plus random plasma glucose levels > or = 200 mg/dlL (11.1 mmol/L).

Symptoms are polyuria, polydipsia, unexplained weight loss.

- Fasting plasma levels > = 126 mg/dL (7 mmol/L) after a minimum of 8 hour fasting period
- 2h post load glucose > = 200 mg/dL (11.1 mmol/L) after a 75 g load

ADA criteria for gestational diabetes mellitus

first step: If plasma glucose > 140 mg/dL (7.8 mmol/L) after 50 g glucose load proceed to step two second step of diagnosis of gestational diabetes mellitus: If two or more values in the 3 h oral 100 g glucose load are abnormal

fasting:	> 105 mg/dL (5.8 mmol/L)
1 hour:	> 190 mg/dL (10.5 mmol/L)
2 hour:	> 165 mg/dL (9.2 mmol/L)
3 hour:	> 145 mg/dL (8 mmol/L)

WHO recommendations:

For impaired glucose tolerance defined as fasting glucose levels of 100 - 125 mg/dL (5.6 - 6.9 mmol/L) the WHO recommends to perform a 2 h oral glucose tolerance test: overnight fasting, in the morning oral intake of 75 g glucose (for children 1.75 g glucose per kg body weight).

-Impaired fasting glucose category: preload fasting 100 - 125 mg/dL (5.6 - 6.9 mmol/L)

-Impaired glucose tolerance category: fasting < 126 mg/dL (6.9 mmol/L) and 2 h post load glucose level 140 - 199 mg/dL (7.8 - 11mmol/L)

-Diabetes mellitus: preload fasting > or = 126 mg/dL (7 mmol/L) and 2 hour > or = 200 mg/dL (11.1 mmol/L)

4. Whole Blood Glucose

Background: Glucose concentrations differ: Plasma glucose levels are approx. 11% higher than those in whole blood.

Whole blood glucose is used in instruments for self-monitoring. To adjust results from theses devices to plasma glucose the following is recommended for readings > 75 mg/dL (4.2 mmol/L) the difference should be less than 20%, for readings below 75 mg/dL, the difference should be less than 15 mg/dL (0.83 mmol/L).

Limitations: Mannitol, hematocrit, drugs, instrument cleaning, pO2, low total protein concentration may alter the results.

Reference Interval: adults 65 - 95 mg/dL (3.5 - 5.3 mmol/L)

5. Urine Glucose

Background: Exceeding of renal tubular threshold leads glucose loss in the urine.

Useful test in immediate evaluation of a comatose patient by dipstick method and evaluation of newborns.

Sampling: 5 mL random urine

Reference Interval: < 15 mg/dL (spontaneous urine)
< 20 mg/dL (morning urine)
< 0.5 g/24 h (24 h collection urine)

Glucose, Liquor see Cerebrospinal Fluid (CSF, Liquor)

Glucose-6-Phosphate Dehydrogenase (G6PD), RBC f

Background: G6PD is a red blood cell (RBC) enzyme maintaining proteins in a reduced state, is X linked and one or a combination of 60 known mutations within the encoding gene results in premature hemolysis.

The defect is the most common metabolic red blood cell defect with hemolysis.

Useful in the evaluation of G6PD deficiency, occurring in RBC stressful conditions such as bacterial and viral infections or acidosis. Screening is more likely to avoid false negative results if not performed in an acute hemolytic episode, recovery period should be preferred.

In 10% - 15% of Afro-Americans mutations associated with G6PD are present; the G6PD A-variant for example is associated with acute intermittent hemolysis and primaquine sensitivity. Other mutations are linked to drug sensitivities such as aspirin, doxorubicin, furazolidone, nalidixic acid, niridazole, nitrofurantoin, pentaquine, phenylhydrazine, quinidine, quinine, sulfamethoxazole, sulfapyridine and others.

Sampling: 2 mL EDTA blood, do not freeze, stable at room temperature for 1 day, at 4°C for 6 days.

Reference Interval: 7.2 - 10.5 U/g hemoglobin
In newborns higher.

Glutamanic Acid Decarboxylase Antibody (GAD) f

Related Information: Glucose
Islet Cell Antibody
Parietal Cell Antibody
Thyroglobulin Antibody
Thyroperoxidase Autoantibody

Background: The enzyme GAD is part of the neurotransmitter GABA production pathway in pancreas and CNS.

GDA antibodies are of IgG class.

Useful in the diagnosis of:

- GDA antibodies are present in up to 95% of Stiff Man syndrome patients. Stiff Man syndrome is a rare disease characterized by progressive stiffness of skeletal muscles, particularly legs and back, rigors, spasms, hyperlordosis of the spine. Women predominate. Clinically seen between third

and seventh decade of life. Associated with diabetes mellitus, in up to 60% of the patients with autoimmune diseases such as thyroiditis, Graves disease, pernicious anemia, myasthenia gravis; in up to 5% in breast carcinoma, Hodgkin's disease, carcinoma of the colon, carcinoma of the lung -Diabetes mellitus:

GDA antibodies are present in 70% - 80% in type I diabetes in children and adults. Indicated parameter in pathologic or borderline glucose tolerance tests in children in combination with other autoantibodies tests and familiar history of diabetes. However, sensitivity is 60% - 90% for adults and as low as 3% - 20% for children to develop within 5 - 10 years diabetes type I if GAD antibodies are present.

Predictive value for adults with type II diabetes for developing insulin dependent diabetes within 6 years is 80%.

Sampling: 1 mL serum

Reference Interval: Negative : < 0.75 U/mL

Glutamate Oxaloacetic Transaminase (GOT) see Aspartate Aminotransferase, Serum

Glutamate Pyruvate Transaminase (GPT) see Alanine Aminotransferase (ALT), Serum

Glutamic Pyruvate Transaminase see Alanine Aminotransferase (ALT), Serum

Glycosylated Hemoglobin A1c , Blood a

Related Information: Fetal Hemoglobin
Fructosamine, Serum
Glucose, Blood, Urine, Liquor
Triglycerides, Serum or Plasma

Synonyms: Fast Hemoglobins, GHb, Glycohemoglobin, HB A1, Hemoglobin A1a ,A1b ,A1c.

Background: GHb is composed of varies compounds formed by ligation of sugars and hemoglobin. The formation rate of GHb is proportional to blood glucose concentration.

Essential parameter in long term glucose control. GHb reflects blood glucose levels over the preceding 60 - 120 days. Goal should be values < 7%, diabetes mellitus treatment need to be reevaluated if GHb > 8%.

Sampling: 1 mL of EDTA or heparin blood. Stable 1 week at 4°C.

It is recommended a three month interval testing for type I diabetes mellitus, for type II diabetes 6 month.

Reference Interval: 4.8% - 6.2%