COMPLETE BLOOD COUNT (CBC).

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RFTS

CREATININE

Creatinine is a nitrogenous waste product formed from the metabolism of creatine in skeletal muscle. Creatinine diffuses freely throughout the body water. It is filtered from the extracellular fluid by the kidney and excreted in the urine.

The excretion of Creatinine is mainly renal and in the absence of disease, excretion is relatively constant.

Value of test

Measurement of serum or plasma creatinine is an important test of kidney function. It is recommended in preference to the measurement of serum or plasma urea because it is a better indicator of overall renal function and progress in renal failure.

Serum creatinine levels are less affected than urea levels by age, dehydration, and catabolic states, e.g. fever, sepsis, and internal bleeding. Creatinine levels are also less influenced by changes in diet such as low intake of protein (providing this is not prolonged).

Increasingly the measurement of serum creatinine is being used to investigate HIV associated renal disease and to monitor patients being treated with nephrotoxic antiretroviral drugs, e.g. tenofovir.

TEST RESULTS

Approximate creatinine reference (normal) range

Males: 0.7–1.4 mg/dl

Females: 0.4–1.2 mg/dl

Note: Reference values for serum or plasma creatinine are slightly lower in children. Values depend on muscle mass.

Interpretation of serum or plasma creatinine results

Increases

Any disease or condition that causes a fall in the glomerular filtration rate (GFR) will increase plasma creatinine levels. Because creatinine is so readily excreted, blood levels rise more slowly than do urea levels in renal disease with slight increases occurring when there is moderate renal damage.

Diseases that can cause renal failure with a reduced GFR include glomerulonephritis (inflammation of the kidney glomeruli), pyelonephritis (inflammation of the pelvis of the kidney), and renal tuberculosis. Diseases causing obstruction of urine outflow may also lead to kidney failure, e.g. urethral structures, prostatic enlargement, cancer of the bladder, and urinary schistosomiasis.

Acute renal failure is often due to sudden reduced blood flow to the kidney occurring in haemorrhage, obstetrical and surgical emergencies, malaria, and septicemia.

Non-renal causes of increased plasma creatinine levels include strenuous exercise and the effect of drugs such as salicylates

Decreases

Diseases associated with muscle wasting reduce the level of creatinine in the blood. In general, however, decreases in concentration are of little significance because serum or plasma creatinine levels are proportional to the muscle mass of an individual.

SERUM OR PLASMA UREA

Urea is the main waste product of protein breakdown. It is formed in the liver by the reactions of the Krebs urea cycle. The rate of reabsorption is inversely related to the rate of urine flow. When the rate of urine flow is low, more urea is absorbed.

Value of test

As a test of renal function, the measurement of plasma urea is less useful than the measurement of plasma creatinine. Urea levels are affected by several factors including state of hydration and dietary intake. These factors have little effect on plasma creatinine levels. Whenever possible therefore, creatinine should be measured in preference to urea in the investigation and monitoring of renal function

Interpretation of serum or plasma urea results

Increases

A marked and prolonged increase in serum or plasma urea is indicative of damaged renal function.

Non-renal causes*:* Slight increases in urea (not more than three times the upper limit of the reference range) may occur when there is:

– Dehydration

– Diuretic therapy

– Gastrointestinal blood loss

– Any condition associated with increased protein breakdown such as pneumonia, malaria, meningitis, typhoid, major trauma, and surgical operations.

Decreases

Low urea levels may be found in:

– Pregnancy

– Malnutrition and AIDS

– Severe liver disease

– Water overload

LIVER FUNCTIONAL TESTS (LFTS)

SERUM OR PLASMA ALANINE AMINOTRANSFERASE (ALT) and AST

Value of test

Measurement of ALT activity is mainly performed to investigate liver disease. Increasingly ALT is being measured to monitor patients receiving antiretroviral drugs associated with hepatotoxicity such as nevirapine (NVP) and stavudine (d47). While both ALT and AST are raised with hepatocellular injury, ALT is more specific for detecting liver cell damage.

Large amounts of AST are present in the liver, kidneys, cardiac muscle, and skeletal muscle. Small amounts of the enzyme are present in the brain, pancreas, and lungs. ALT is found principally in the liver with only small amounts being present in other organs. When there is liver cell damage the serum or plasma levels of both enzymes are raised.

TEST RESULTS

Approximate ALT reference (normal) range 5–35 IU/l

Interpretation of serum or plasma ALT and AST results

Liver disease

The most important cause of raised ALT activity is hepatocellular injury. With acute hepatocellular injury, AST levels are usually higher than ALT levels. As damage continues, ALT activity becomes higher. In viral hepatitis, both enzymes are usually raised before the patient becomes jaundiced. In cirrhosis, ALT levels fall below AST levels. Both ALT and AST are raised in hepatitis caused by hepatotoxic antiretroviral drugs.

Obstructive liver disease is usually accompanied by only small or moderate ALT and AST rises especially in the early stages. With complete obstruction, enzyme levels fall.

Myocardial infarction

An important cause of elevated AST activity is myocardial infarction, i.e. destruction of an area of heart muscle because its blood supply has been cut off due to a blood clot in a coronary artery. The enzyme level rises soon after the coronary vessel becomes blocked, reaches its highest value 24–48 hours after the infarct and returns to normal usually within 3–5 days. In general, the more extensive the infarct, the higher the AST peak level.

Other causes of raised AST levels

Because AST is widely distributed in body tissues many other diseases involving cellular injury may be accompanied by increases in AST levels, e.g. severe bacterial infections, malaria, pneumonia, infectious mononucleosis, pulmonary infarcts, and tumors. AST activity is also increased in some muscle disorders and following surgery, injury, or blood transfusion.

FULL BLOOD CELL COUNT

	Number	**Percentage**
ADULTS		
Neutrophils	1.5–7.5 x 10^9/l	(40–75%)
Lymphocytes‡ . . .	1.2–4.0 " "	(21–40%)
Monocytes	0.2–1.0 " "	(2–10%)
Eosinophils	0.02–0.6 " "	(1–6%)
Basophils	0.01–0.1 " "	(0–1%)

CHILDREN (2–6 year)

Neutrophils . . . . . 1.5–6.5 x 10^9/l	(20–45%)
Lymphocytes‡ . . . 6.0–8.5 " "	(45–70%)
Monocytes . . . . . 0.1–1.0 " "	(2–10%)
Eosinophils . . . . . 0.3–1.0 " "	(1–6%)
Basophils. . . . . 0.01–0.1 " "	(0.1–1%)

Neutrophilia An absolute increase in neutrophils can be found in:

- Acute bacterial infections (often with left shift), e.g. abscesses, wound infections, meningitis, pneumonia, gonorrhoea, urinary tract infections
- Tissue damage, e.g. burns, trauma
- Snake envenomation
- Acute myocardial infarction
- Acute haemorrhage
- Malignant diseases
- Myeloid leukaemia
- Reactions to some drugs e.g. steroid therapy, and chemicals
- Metabolic disorders
- During pregnancy (normal) and delivery

Neutropenia Common causes of a reduced neutrophil count are:

- Bone marrow failure
- Viral infections, e.g. HIV disease, hepatitis, influenza
- Bacterial infections, e.g. typhoid fever, brucellosis, miliary tuberculosis, overwhelming septicemia
- Splenomegaly
- Megaloblastic anaemia
- Drugs

Lymphocytosis An absolute increase in lymphocytes can be found in:

- Infections in children, e.g. whooping cough, mumps, measles, chicken pox
- Bacterial infections, e.g. brucellosis, typhoid fever, chronic tuberculosis, syphilis
- Protozoal infections, e.g. malaria, toxoplasmosis
- Infectious mononucleosis

- Cytomegalovirus infection
- Lymphocytic leukaemia, lymphomas

Lymphopenia Common causes of a reduced lymphocyte count are:

- HIV/AIDS
- Severe bone marrow failure
- Hodgkins disease
- Some acute viral infections

Monocytosis An absolute increase in monocytes can be found in:

- Chronic bacterial infections, e.g. tuberculosis, brucellosis, typhoid, bacterial endocarditis
- Protozoal infections, e.g. malaria, trypanosomiasis
- Chronic myelomonocytic leukemia
- Hodgkins disease

Eosinophilia An absolute increase in eosinophils can be found in:

- Helminth infections, e.g. hookworm infection, strongyloidiasis, flilariasis, trichinosis, schistosomiasis, hydatid disease
- Allergic conditions, e.g. asthma, hay fever, urticaria, food allergies, drug allergies
- Skin diseases, e.g. psoriasis, dermatitis
- Hodgkins disease, lymphoma, malignancies
- Connective tissue diseases

Basophilia An absolute increase in basophils can be found in:

- Myeloproliferative disorders
- Some allergies
- Myxoedema

PLATELET COUNT

Value of test: A platelet count may be requested to investigate abnormal skin and mucosal bleeding which can occur when the platelet count is very low (usually below 20x 10^9/l). Platelet

counts are also performed when patients are being treated with cytotoxic drugs or other drugs which may cause thrombocytopenia.

Interpretation of platelets counts

In health there are about 150–400 x 10^9 platelets/litre of blood.

Thrombocytopenia

The main causes for a reduction in platelet numbers are:

● Infections, e.g. typhoid, brucellosis

● Deficiency of folate or vitamin B12

● Aplastic anaemia

● Drugs (e.g. cytotoxic, quinine, aspirin), chemicals (e.g. benzene), some herbal remedies, alcoholism

● Leukaemias, lymphoma, myeloma, myelofibrosis, carcinoma

● Hereditary thrombocytopenia (rare condition).

Increased destruction or consumption of platelets

● Infections, e.g. acute falciparum malaria, dengue, trypanosomiasis, visceral leishmaniasis

● Disseminated intravascular coagulation (DIC)

● Hypersplenism

● Immune destruction of platelets, e.g. idiopathic thrombocytopenic purpura (ITP), systemic lupus erythematosus (SLE), other connective tissue disorders, chronic lymphatic leukaemia, lymphomas and HIV/AIDS. Also, exposure to drugs, e.g. quinine, mefloquine, penicillin, and some herbal remedies.