

# Interpretation of Clinical Laboratory Tests



**Centurion**  
**UNIVERSITY**

**Suman Kumar Meikap**  
**Asst. Professor**  
**CUTM, Bhubaneswar**

# CLINICAL LABORATORY TEST



Clinical laboratory test results are a very important parameter in diagnosis monitoring and screening. 70-80 % of decisions in diagnosis are based on laboratory results and more and more laboratory analyses are requested. Thus a lot of data are provided and that is therefore imperative for patient care (and safety) that the clinicians are familiar with the tests and with interpretation of the results.

## What is lab result mean?

- Lab test results may be positive, negative, or inconclusive. Your doctor will discuss what your test results mean for you and your health.
- **A positive test** result means that the substance or condition being tested for was found. Positive test results also can mean that the amount of a substance being tested for is higher or lower than normal.
- **A negative test** results means that the **substance or condition being tested for was not found**. Negative results can also mean that the substance being tested for was present in a normal amount.
- **Inconclusive test** results are those that are not clearly positive. For example, some tests measure the level of antibodies to some bacteria or viruses in blood or other fluid to look for an infection. It is not always clear if the level of antibodies is high enough to indicate an infection.

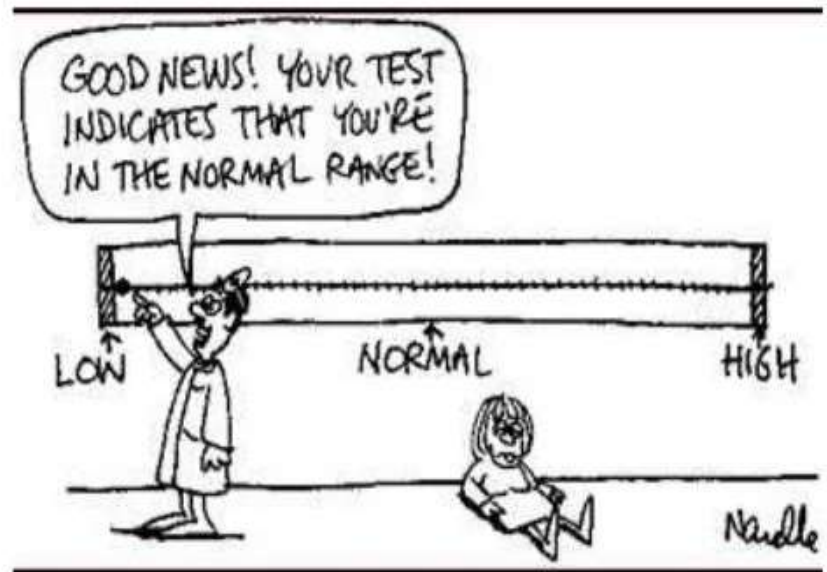
## What are false-positive and false-negative test results?



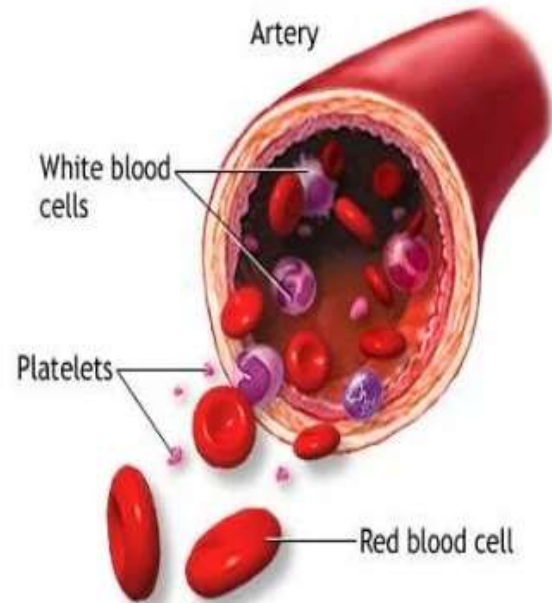
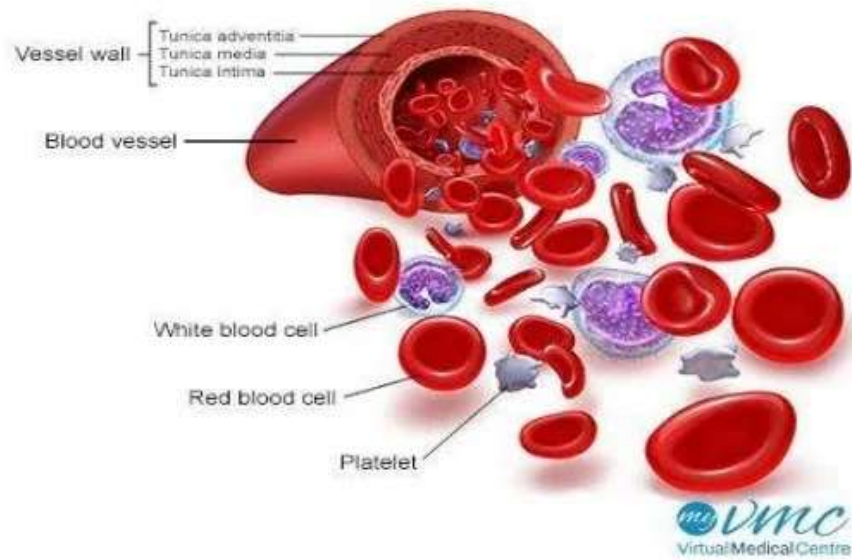
- A **false-positive** test result is one that shows a disease or condition is present when it is not present. A false-positive test result may suggest that a person has the disease or condition when he or she does not have it. For example, a false-positive **pregnancy test** result would appear to detect the substance that confirms **pregnancy**, when in reality the woman is not pregnant.
- A **false-negative** test result is one that does not detect what is being tested for even though it is present. A false-negative test result may suggest that a person does not have a disease or condition being tested for when he or she does have it. For example, a false-negative pregnancy test result would be one that does not detect the substance that confirms pregnancy, when the women really is pregnant.

## What if your results are different than the reference range?

- It is possible that is different than the reference range even though nothing is wrong with you.
- Sometimes certain factors can affect your test results, such as:
  - ✓ Pregnancy
  - ✓ Medicine you are taking
  - ✓ Eating right before a test
  - ✓ smoking
  - ✓ Being under stress



# Completed Blood Count



# Completed Blood Count



## RED BLOOD CELLS

### SI unit (normal value)

Male 4.3-5.9\*10<sup>6</sup>/mL

Female 3.5 5.0\*10<sup>6</sup>/mL

## Platelets

### SI unit (normal value) :

150000-450000/ $\mu$ L

## WHITE BLOOD CELLS

### SI unit (normal value) : 4000–11000/ $\mu$ L

Neutrophils : 2500-7500/ $\mu$ L

Eosinophil's: 500/ $\mu$ L

Basophils: 0-300/ $\mu$ L

Lymphocytes: 3000/ $\mu$ L

Monocytes: 200-600/  $\mu$ L

## Hemoglobin

### SI unit (normal value) :

Male 14–18 g/dL

Female 12–16 g/dL

# RED BLOOD CELLS

## DEFICIENCY OF RBC

**Hemolytic anemia:**  
Decrease no of RBC

Excess bleeding

**Hereditary spherocytosis :**  
Rare blood disorder in which defects in the red blood cells cause them to be shaped like spheres and break down easily.





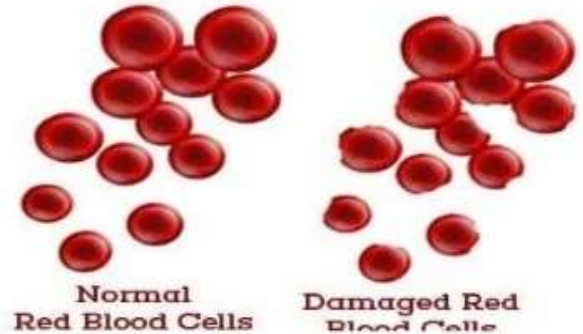
# RED BLOOD CELLS

## EFICIENCY OF RBC

### Polycythemia:

**Primary polycythemia:** Caused by overproduction of red blood cells by the bone marrow due to mutation or biological factor in the body.

**Secondary polycythemia:** Caused by factors that reduce the amount of oxygen reaching the body's tissues, such as smoking, high altitude or congenital heart disease. The red blood cells in some patients with secondary polycythemia may carry an abnormal form of hemoglobin that does not release oxygen readily (high-affinity hemoglobin).



# RED BLOOD CELLS

## Red blood cell enzyme disorders:

Glucose-6-phosphate  
dehydrogenase (G6PD)

Pyruvate kinase deficiency

Glycolytic red cell disorders

Deficiency is an X-linked disorder most commonly characterized by episodic haemolysis in the setting of oxidative triggers, such as fava beans, infections, and certain medications.

Should be suspected in patients of all ages with a chronic hemolytic anaemia in the absence of immune-mediated haemolysis, a hemoglobinopathy, or evidence of a red cell membrane disorder.

Cause congenital hemolytic anemias with wide clinical heterogeneity and frequent complications, including neonatal jaundice, gallstones, and both transfusion-related and transfusion-independent iron loading.

# WHITE BLOOD CELLS

## Deficiency of WBC

1. **Leukopenia:** Decrease no of WBC
2. **Neutropenia:** Decrease no of neutrophils ( aplastic anemia, chemotherapy, myelodysplasia, typhoid fever, hyperglycemia)
3. **Basopenia:** Decrease no of basophils (thyrotoxicosis, acute hypersensitivity reactions)
4. **Lymphocytopenia:** Decrease no of lymphocytes (viral infection, systemic lupus erythematosus (SLS), rheumatoid arthritis, myasthenia gravis)
5. **Monocytopenia:** Decrease no of monocytes (**MonoMac Syndrome** (the risk of infection with certain organisms, including a group of bacteria known as Mycobacterium avium complex (MAC) that are related to tuberculosis, human papillomavirus (HPV), and certain fungi.



# WHITE BLOOD CELLS

## Elevation in WBC

**Leukocytosis:** Increase no of WBC

**Neutrophilic leukocytosis:** Increase no of neutrophils

**Basophilia:** Increase no of basophils  
(hypothyroidism, myeloproliferative disorders)

**Eosinophilia:** Increase no of eosinophils  
(parasitic and fungal disease, allergies, skin disorders, toxins)

**Monocytosis:** Increase no of monocytes  
(sarcoidosis, and Langerhans cell histiocytosis, autoimmune disorder)



**Tuberculosis**

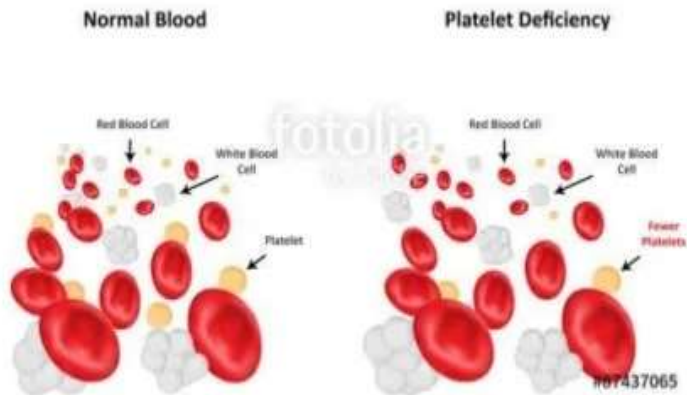


**Hodgkin's syndrome**

# PLATELETS

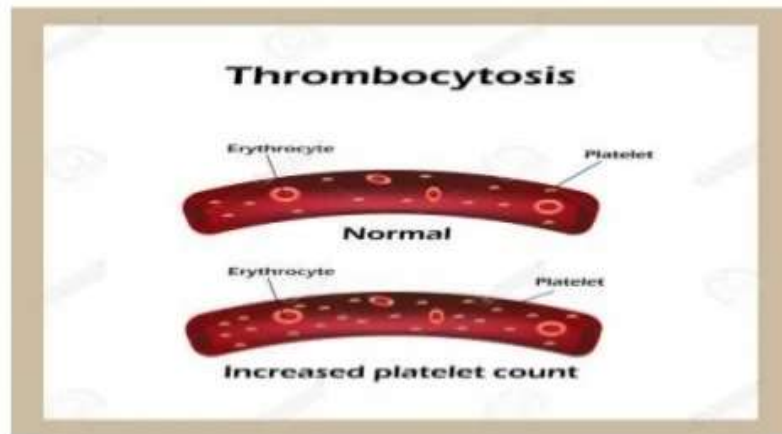
## Deficiency of Platelets

**Thrombocytopenia**  
Low number of platelets  
**Thrombocytopenia**



## Elevation in Platelets:

**Thrombocytosis** : Increase number of platelets (acute bleeding and blood loss, cancer, infections, removal of spleen,



# PLATELETS

## Blood clotting test

### Factor V assay:

This test measures Factor V, a substance involved in clotting. An abnormally low level may be indicative of liver disease, primary fibrinolysis (a breakdown of clots), or disseminated intravascular coagulation (DIC).

### Fibrinogen level

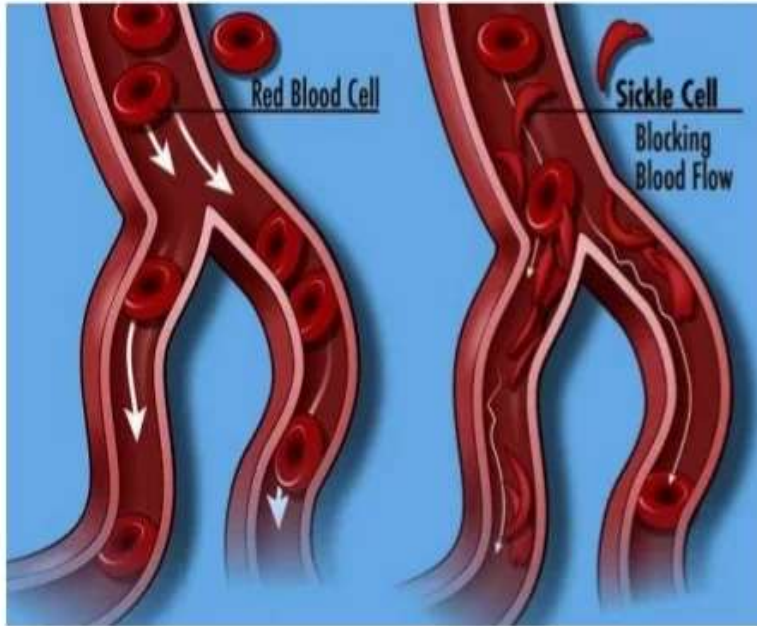
Fibrinogen is a protein made by your liver. This test measures how much fibrinogen is in your blood. Abnormal results may be a sign of excessive bleeding or **hemorrhage**, **fibrinolysis**, or **placental abruption**, which is a separation of the placenta from the uterine wall.

### Prothrombin time (PT or PT-INR)

Prothrombin is another protein your liver produces. The prothrombin time (PT) test measures how well and how long it takes your blood to clot. It normally takes about **25 to 30** seconds. It may take longer if you take blood thinners. Other reasons for abnormal results include **hemophilia**, **liver disease**, and **malabsorption**. It's also useful in monitoring those who take medications that affect clotting, such as **warfarin** (Coumadin).

Blood clotting test	Time/ concentration
PT	9.0-11.7 sec
INR (coumadin)	0.9-1.2 sec
PTT (Heparin monitoring)	55.0-75.0 sec
APTT (therapeutic)	23.3-31.9 sec
Fibrinogen	203-377 mg/dl

# HAEMOGLOBIN



**Normocytic:** Hemoglobin levels are decrease but RBC size is normal (acute blood loss, anemia of chronic disease).

**Microcytic:** Insufficiency of hemoglobin synthesis (iron deficiency of anemia, thalassemia)

**Macrocytic:** Deficiency of vitamin B1 or folic acid (hypothyroidism, alcoholism)

**Sickle cell anemia:** alteration in hemoglobin structure

# LABORATORY TEST FOR CARDIO VASCULAR SYSTEM





# LABORATORY TEST FOR CARDIO VASCULAR SYSTEM



## TROPONIN

When muscle or heart cells are injured, troponin leaks out, and its level in blood is rise. Blood level of troponin rise when you have heart attack.

## Creatine Kinase (CK)

Diagnosis for acute MI, elevated level of CK diagnose myocardial infraction.

**Normal value :** <150 units/L

## B-type natriuretic peptide test

Measures levels of a protein called BPN that is made by your heart and blood vessels. NP levels are higher than normal when you have heart failure.



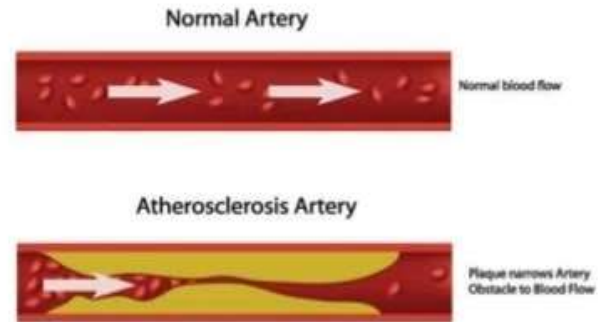
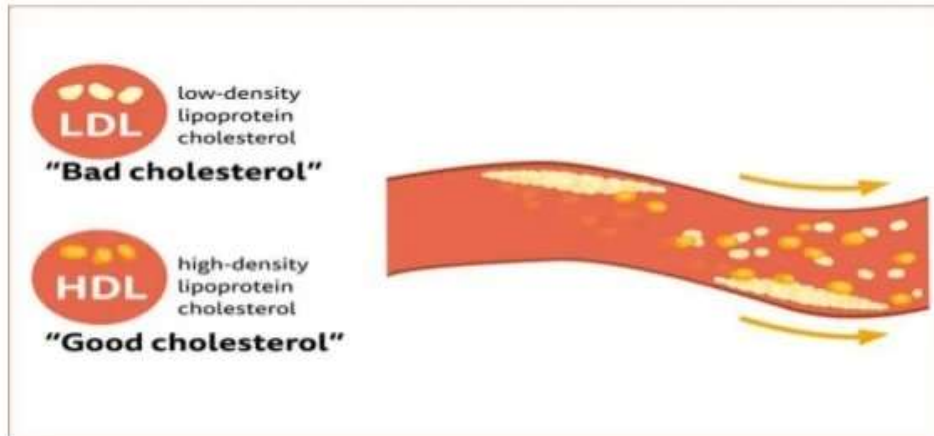
## C-reactive protein (CRP)

CRP is a marker for inflammation, and atherosclerosis has an inflammatory component. Patients with elevated levels of CRP have an increased risk for heart attack, stroke, sudden death, and vascular disease.

# LABORATORY TEST FOR CARDIO VASCULAR SYSTEM

## Measurement of total cholesterol

- ❖ A lipoprotein panel is a blood test that can help show whether you are at risk for coronary heart disease (CHD). This test looks at substances in your blood that carry cholesterol.



## Reference ranges to measure cholesterol

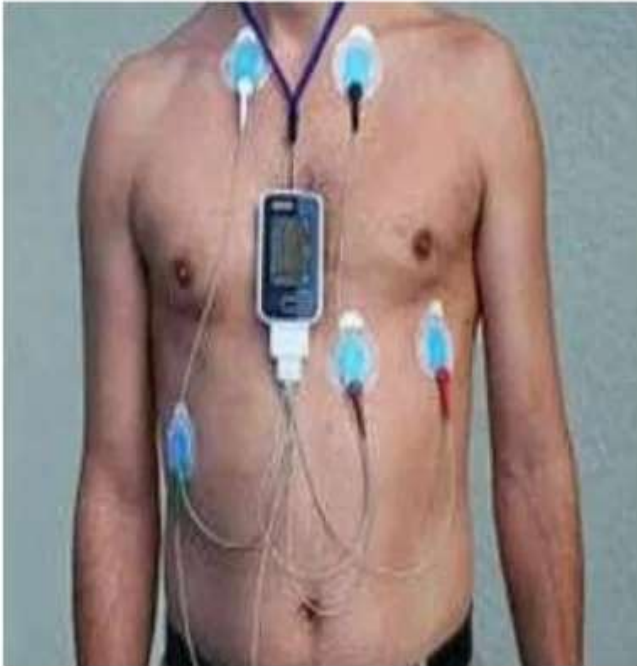
HDL cholesterol level	HDL cholesterol category
Less than 40 mg/dL	A major risk factor for heart disease
40-59 mg/dL	The higher, the better
60 mg/dL and above	Considered protective against heart disease

Triglyceride level	Triglyceride cholesterol category
Less than 150mg/dL	Optimal
150-199 mg/dL	Borderline high
200-499 mg/dL	High
500 mg/dL	Very high

LDL cholesterol level	LDL cholesterol category
Less than 100mg/dL	Optimal
100-129 mg/dL	Near optimal / above optimal
130-159 mg/dL	Borderline high
160-189 mg/dL	High
190 mg/dL and above	Very high

Total cholesterol level	Total cholesterol category
Less than 200mg/dL	Desirable
200-229 mg/dL	Borderline high
240 mg/dL and above	High

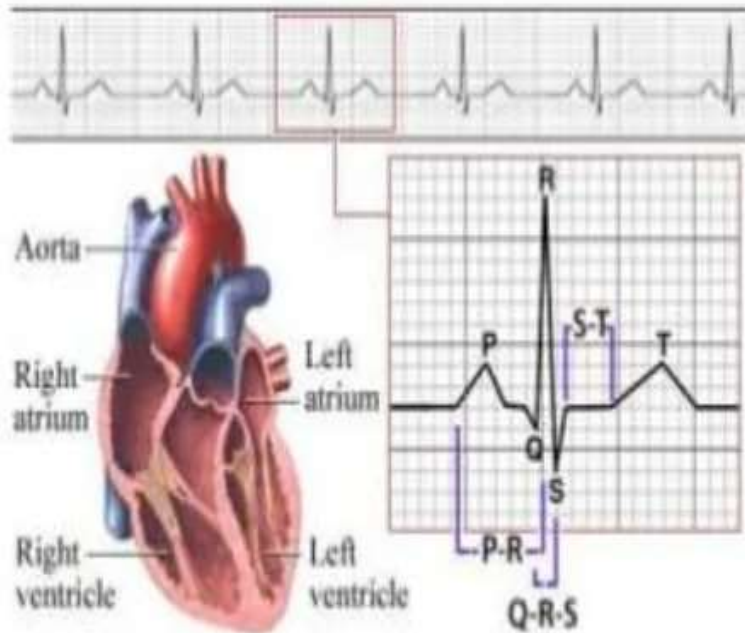
# HEART FUNCTION TESTS



## Holter monitoring

A holter monitor is usually worn 24 hours and record every heart beat for that time period. Electrodes are placed on the chest, and a recorder is worn on a shoulder strap or belt. It is ordered to identify cardiac arrhythmias, and to monitor how well medication is working to minimize them.

# HEART FUNCTION TESTS

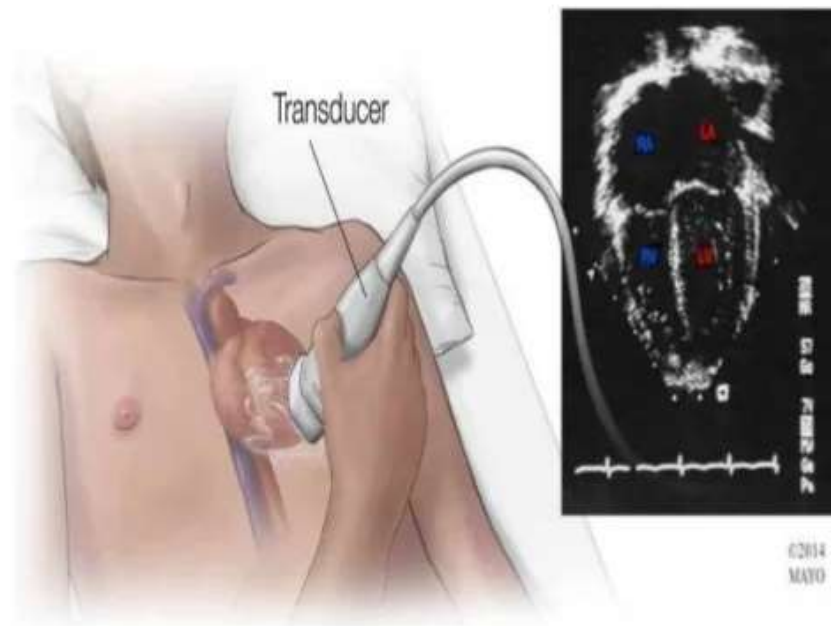


## Electrocardiogram (ECG)

An ECG is a cardiac screening test that should be done on everyone on their first visit to a cardiologist. An EKG establishes baseline information about the structure of heart, its electrical conduction patterns and possible arrhythmias.

# HEART FUNCTION TESTS

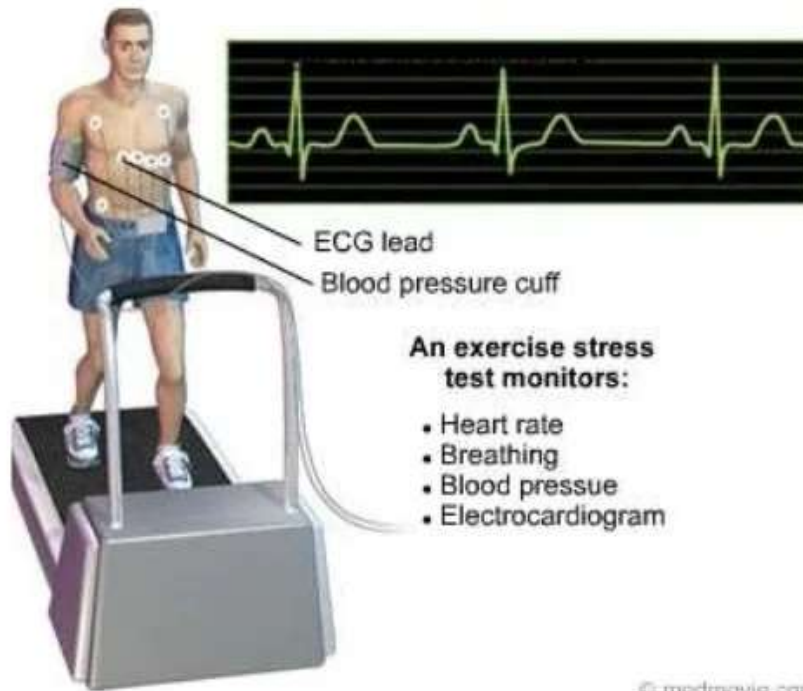
Echocardiogram



## Echocardiogram

An echocardiogram is a noninvasive ultrasound cardiac screening test that records specific geographical areas of the beating heart, which reveals blood flow patterns and allows us to measure size and wall thickness of the heart's chambers.

# HEART FUNCTION TESTS



© medmovie.com


## Exercise/ Nuclear stress test

An exercise stress heart test is ordered to assess how heart is functioning when heart rate and blood pressure are increased during physical exertion.

# LIVER FUNCTION TESTS







### **Alanine Transaminase test (ALT)**


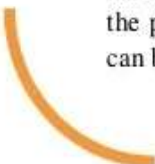
ALT is an enzyme mainly found in your liver. The ALT test measures the level of ALT in your blood. Consistently high levels of ALT in your blood can be a sign of liver damage.

### **Alkaline Phosphatase test (ALP)**

ALP is an enzyme found in large amounts in your liver, bile ducts, and other parts of your body. The ALP test measures the level of ALP in your blood. High levels of ALP can be a sign of liver or bile duct damage.

### **Albumin test**

Albumin is another protein made in your liver. An albumin test measures how well your liver is making the proteins that your body needs. Low albumin levels can be a sign of liver damage.



### **Aspartate Transaminase test (AST)**

AST is an enzyme found in large amounts in your liver and other parts of your body. The AST test measures the level of AST in your blood. High levels of AST can be a sign of liver damage.

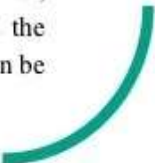
### **Bilirubin test**

A bilirubin test measures the level of bilirubin in your blood. If your liver is damaged, bilirubin can leak out of your liver into your blood and can cause jaundice (yellowing of skin and eyes).



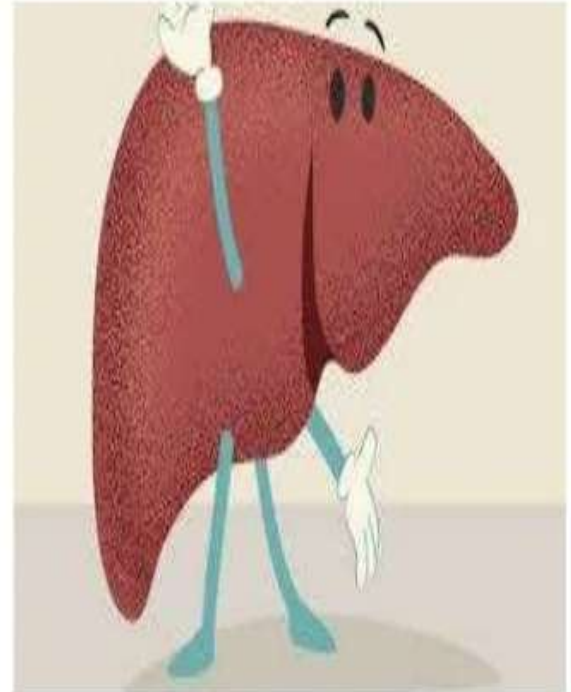
### **Gamma-glutamyl transpeptidase (GGT)**

GGT is an enzyme found in large amounts in your liver, bile ducts, and pancreas. The GGT test measures the level of GGT in your blood. High levels of GGT can be a sign of liver or bile duct damage.

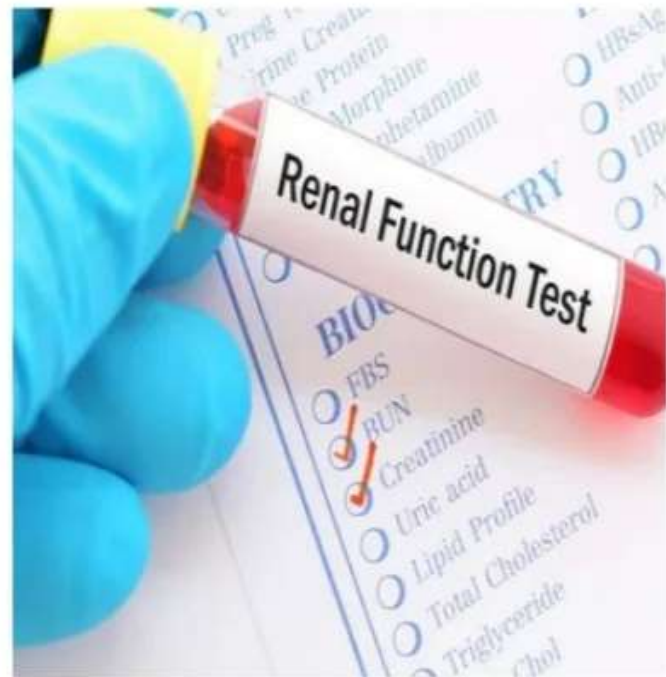
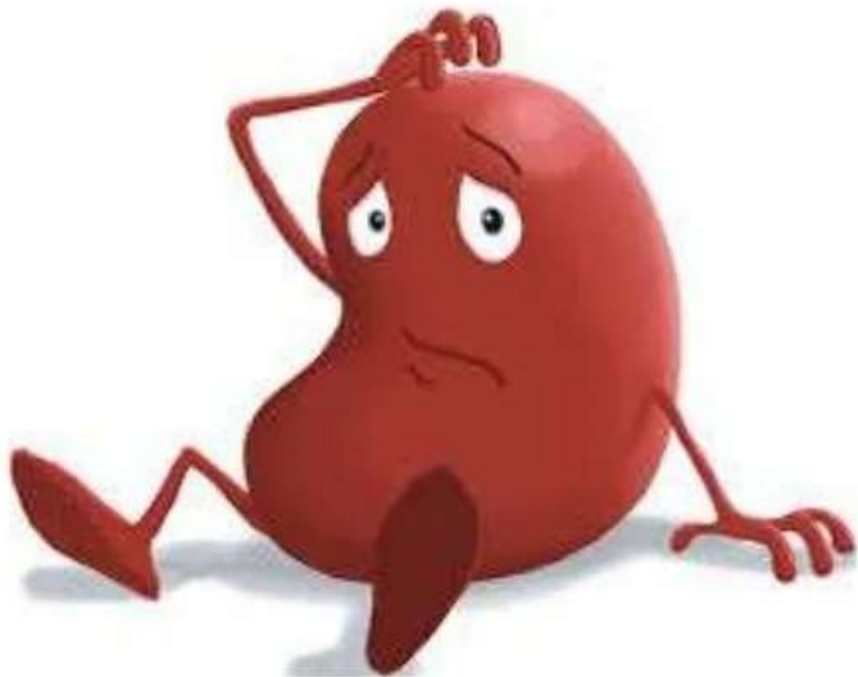


## Reference ranges to measure Liver function tests

Lab result	Normal value	Comment
AST	0-35 units/L	↑ with MI and liver injury
ALT	0-35 units/L	↑ negligibly unless parenchymal liver disease.
ALP	30-120 units/L	↑ in the bile duct obstruction, obstructive liver disease
CGT	0-70 units/L	↑ Sensitive test reflecting hepatocellular injury, usually in chronic alcoholics
Bilirubin (total)	0.1-1 mg/dL	↑ Breakdown product of hemoglobin, bound to albumin, conjugated in liver with hemolysis, cholestasis, liver injury



# KIDNEY FUNCTION TESTS



### **Urea clearance test**

Measure the amount of urea in the blood stream and two urine specimens, collected one hour apart, to determine the amount of urea that is filtered, or cleared, by the kidneys into the urine.

### **Blood urea nitrogen test (BUN)**

Measures the amount of nitrogen contained in the urea. High BUN levels can indicate kidney dysfunction, but because BUN is also affected by protein intake and liver function, the test is usually done together with a blood creatinine, a more specific indicator of kidney function.

### **Urine albumin**

Albumin is one type of protein. When the filters are damaged, they may leak protein into your urine. Albumin levels can go up if you exercise a lot or have high blood sugar, too. Bladder infections can also make the levels go up.

### **Urine osmolality test**

Measurement of the number of dissolved particles in urine. The test may be done on a urine sample collected first thing in the morning, on multiple time samples, or on a cumulative sample collected over a 24-hour period.

### **Creatinine clearance test**

The amount of creatinine in the blood remains relatively constant and normal. For this reason, and because creatinine is affected very little by liver function, an elevated blood creatinine level is a more sensitive indicator of impaired kidney function than the BUN.



### **Other blood test**

Measurement of the blood levels of other elements regulated in part by the kidneys can also be useful in evaluating kidney function. These include sodium, potassium, carbon di oxide bicarbonate, calcium, magnesium, phosphorous, protein, uric acid and glucose.

## Reference ranges to measure Kidney function tests

Lab test	SI unit (normal value)	Comment
Sodium	35-145 mmol/L	<p>↓ usually caused by excess water (e.g., serum antidiuretic hormone) and is treated with water restriction.</p> <p>↑ in severe dehydration, diabetes insipidus, significant renal and GI losses.</p>
Potassium	3.5-5 mmol/L	<p>↑ with renal dysfunction, acidosis, K-sparing diuretics, hemolysis, burn, crush, injuries</p> <p>↓ by diuretics, or with alkaloids, severe vomiting and diarrhea.</p>
CO <sub>2</sub>	22-28 mmol/L	Sum of HCO <sub>3</sub> and dissolved CO <sub>2</sub> . Reflects acid-base balance and compensatory pulmonary (CO <sub>2</sub> ) and renal (HCO <sub>3</sub> -)
Calcium	8.5-10.5 mg/dL	<p>↑ with hyperparathyroidism, paget disease, bone tumor, increased absorption from bone to ECF, decrease neuromuscular activity</p> <p>↓ with dietary deficiency, increased excretion, pancreatitis, hypoparathyroidism, rickets, osteomalacia, renal insufficiency</p>
Chloride	98-106 mEq/L	↑ dehydration, multiple myeloma, kidney disorders, adrenal gland function
Phosphorus	2.4-4.1 mg/dL	↑ kidney and parathyroid gland dysfunction

## Reference ranges to measure Kidney function tests

Lab result	Normal value
Serum creatinine	Women 0.6-1.1 mg/dL Men 0.7-1.3 mg/dL
Creatinine clearance	Women 88-128 mL/min Men 97-137 mL/min
Urine albumin	0-8 mg/dL
BUN	7-20 mg/dL
Urine microalbumin	<30 mg (30-300 mg may mean early CKD, more than 300 mg may mean a later stage CKD)
Albumin to Creatinine ratio	<30 mg/gram



# LABORATORY TESTS FOR DIABETES



# LABORATORY TESTS FOR DIABETES

This table shows the ranges for blood glucose levels after 8 to 12 fasting (not eating). It shows the normal range and the normal ranges are a sign of prediabetes or diabetes.

Plasma Glucose results (mg/dL)	Diagnosis
70-99	Normal
100-125	Prediabetes
126 and above	Diabetes





# LABORATORY TESTS FOR DIABETES

## Oral glucose tolerance test (OGTT)

When blood is drawn	For prediabetes	For diabetes	For gestational diabetes
Fasting	100–125 mg/dL	126 mg/dL or greater	greater than 92 mg/dL
After 1 hour			greater than 180 mg/dL
After 2 hours	140–199 mg/dL	200 mg/dL or greater	greater than 153 mg/dL

## Oral Glucose Tolerance Test



The pathologist will give you:  
**75 ml glucose drink**

Then ask you to:  
**Wait 2 hours**



Take blood  
and test  
glucose  
levels



# LABORATORY TESTS FOR DIABETES

## Haemoglobin A1c (HbA1c)

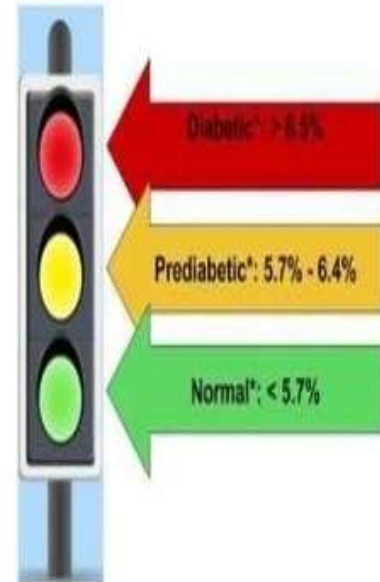
### A1c and Blood Sugar

A1c (%)	Average Blood Sugar (mg/dL)
4	68
5	97
6	126
7	152
8	183
9	212
10	240
11	269
12	298
13	326
14	355

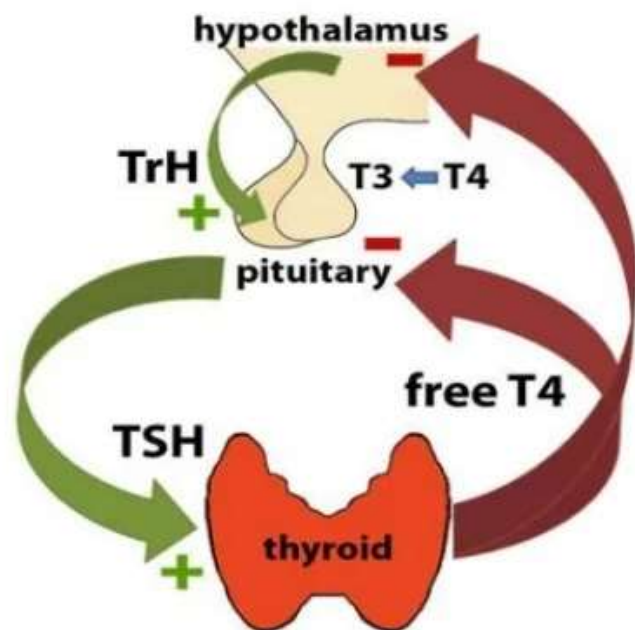
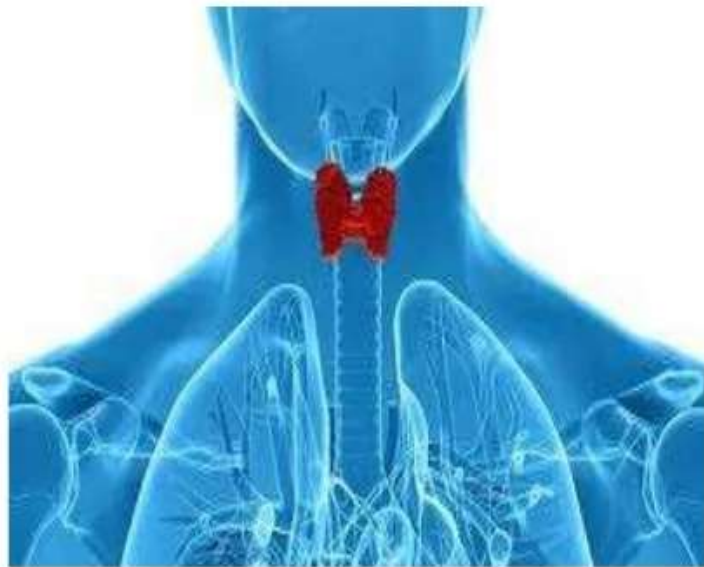
HbA1c test measures the percentage of HbA1c in blood. It reflects the average blood glucose over a period of past two to three months (8 - 12 weeks)

HbA1c refers to hemoglobin which is bound to glucose

- HbA1c test is done to
- Diagnose Diabetes
  - To monitor Diabetes



# LABORATORY TESTS FOR THYROID GLAND



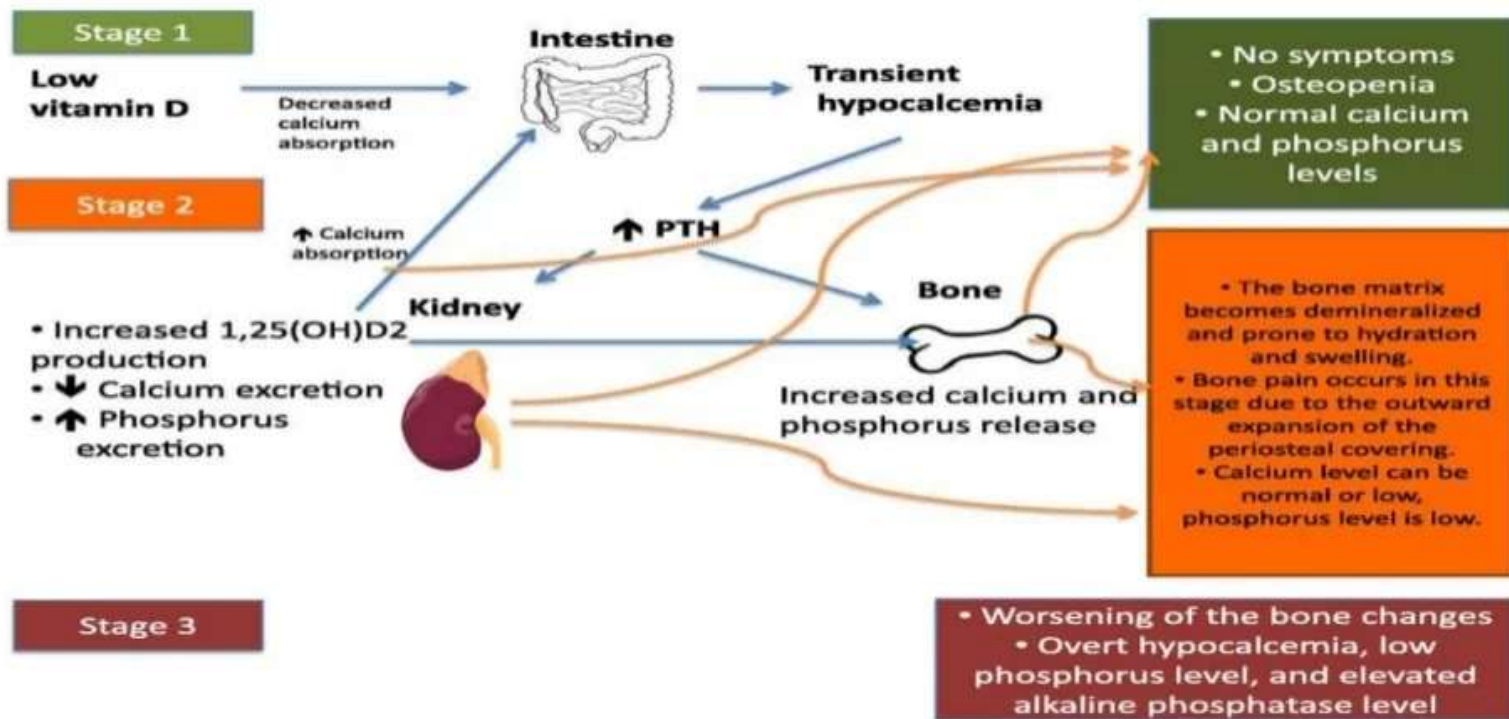
# THYROID FUNCTION TEST

Test	Normal values
TSH	0.4-4.0 mU/L
FT4	9.0-25.0 pmol/L
FT3	3.5-7.8 pmol/L



# LABORATORY TESTS FOR VITAMIN D

Normal range: 30 to 74 ng/mL



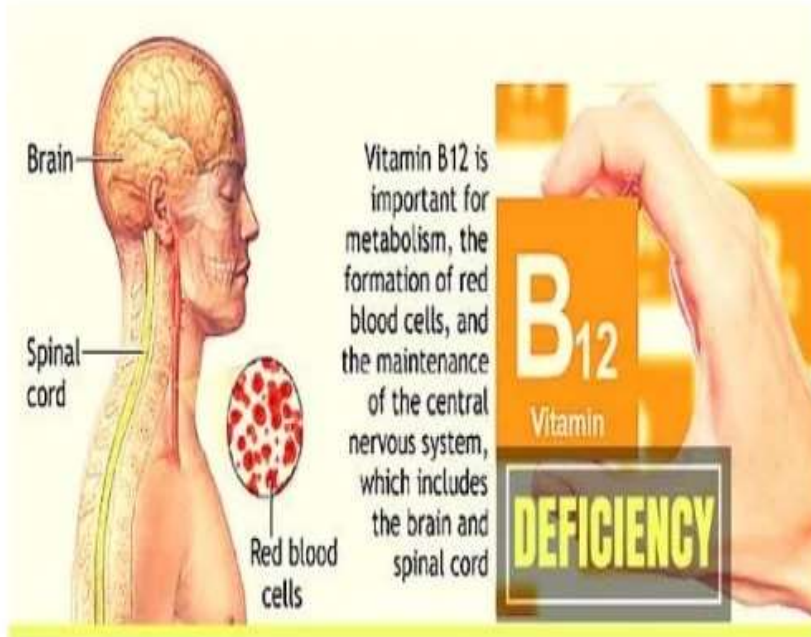
# LABORATORY TESTS FOR VITAMIN B12



## Normal Values

- Infants up to age 6 months: 0.4 mcg
- Babies age 7-12 months: 0.5 mcg
- Children age 1-3 years: 0.9 mcg
- Kids age 4-8 years: 1.2 mcg
- Children age 9-13 years: 1.8 mcg
- Teens age 14-18: 2.4 mcg (2.6 mcg per day if pregnant and 2.8 mcg per day if breastfeeding)
- Adults: 2.4 mcg (2.6 mcg per day if pregnant and 2.8 mcg per day if breastfeeding)

# Vitamin B12



## Deficiency of B12

- Atrophic gastritis, in which stomach lining has thinned
- Pernicious anemia, which makes it hard for your body to absorb vitamin B12
- Conditions that affect your small intestine, such as Crohn's disease, celiac disease, bacterial growth, or a parasite
- Immune system disorders, such as Graves' disease or lupus

# LABORATORY TESTS FOR LUNGS INFECTION



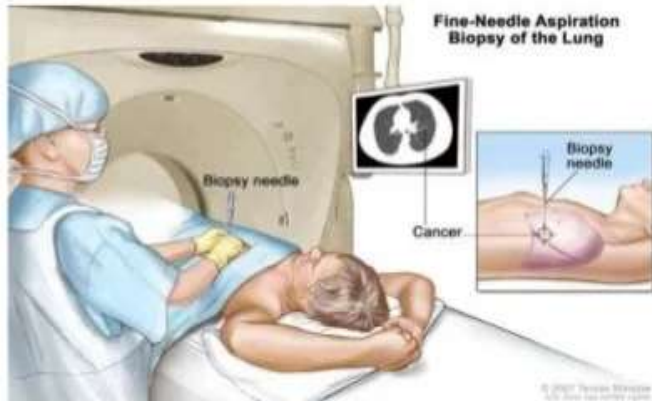


# LABORATORY TESTS FOR LUNGS INFECTION



## Oximetry

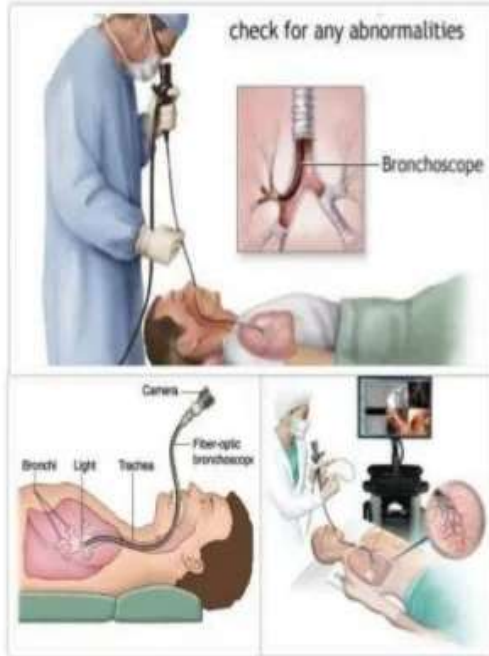
An oximeter can estimate the amount of oxygen in your blood. A sensor in a cuff or clip is placed on the end of your finger. This sensor measures how much oxygen is in your blood. The oximeter machine shows the result.



## Lung biopsy

It is a test done on a very small piece of lung tissue to look for conditions such as lung cancer or fibrous tissue in the lungs (pulmonary fibrosis). Your doctor obtains lung tissue by inserting a needle into your chest between two ribs or by using bronchoscopy.

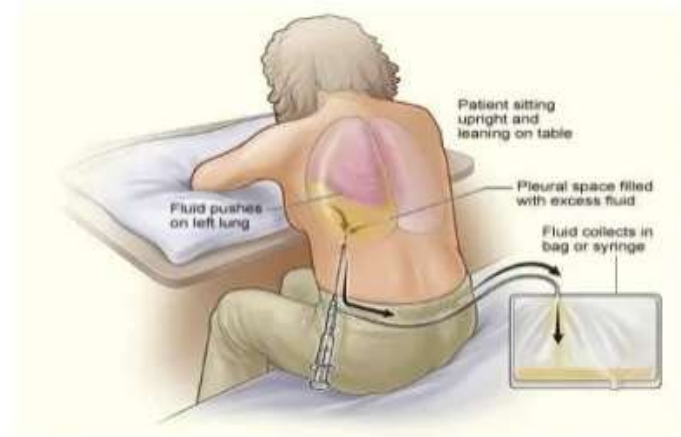
# LABORATORY TESTS FOR LUNGS INFECTION



## **Bronchoscopy**

It is a visual examination of the tubes leading to your lungs. This test is usually done by a respirologist (lung specialist). He or she inserts a small, lighted device through your nose or mouth into the tubes leading to your lungs. During the procedure, the doctor can obtain samples of tissue, fluid, or mucus.

# LABORATORY TESTS FOR LUNGS INFECTION



## Thoracentesis

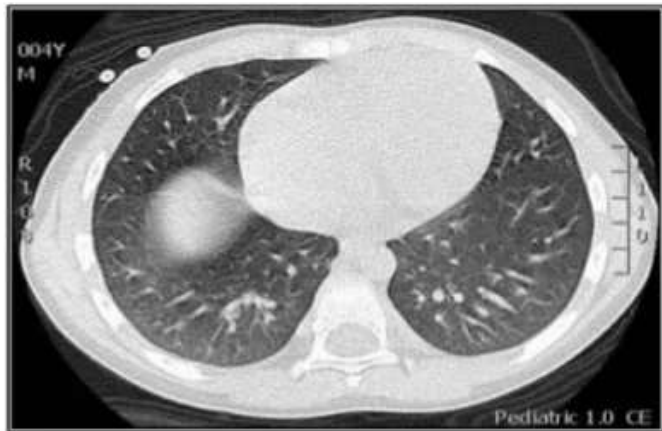
Thoracentesis involves puncturing the chest wall to obtain fluid from the space around the lungs. Fluid obtained during the test can be checked for signs of infection or cancer.



## Blood tests or cultures

Blood tests may help tell whether antibodies to a specific organism that can cause pneumonia are present or whether specific viruses, such as influenza (flu) or respiratory syncytial virus (RSV), are present. Doctors can use blood cultures to test for bacteria in your bloodstream.

# LABORATORY TESTS FOR LUNGS INFECTION



## **Computed tomography (CT) scan**

A CT scan uses X-rays to produce detailed pictures of structures inside your body. It may be used in people who are not responding to their treatment.

## OTHER BLOOD TESTS



# OTHER BLOOD TESTS

## Follicle stimulating hormone (FSH)

Sustained high levels of FSH in a women can indicate that the menopause is approaching or has happened.

**Normal level: 5-20 mIU/ml**



## Progesterone level

Progesterone measurements are often used to determine if ovulation has occurred. The ovaries produce very small amounts of progesterone until ovulation happens.

**Normal level- 3ng/mL**

## Prolactin

It is a pituitary hormone that stimulates and sustains milk production in nursing mothers. High prolactin levels in order to rule out problems, such as a pituitary tumor

Table

### Normal prolactin level ranges

Men	0 to 424 mIU/L (0 to 20 ng/mL)
Women	0 to 530 mIU/L (0 to 25 ng/mL)

Source: Reference 2

# OTHER BLOOD TESTS

## DHEA-S or dehydroepiandrosterone-sulfate

It is a male hormone that is found in all women. DHEA-S is an androgen that is secreted by the adrenal gland. It

**Normal level- 35-430 ug/dl**

**PCOS -greater than 200 ug/dl**

**DHEA - SULPHATE (DHEAS) TEST**



**DHEAS Functions:**

- balance level of water and salt in the body
- keep blood pressure level normal
- help the body fat, protein, and carbohydrates
- developing feminine and masculine characteristics

## Beta Human Chronic Gonadotropin (HCG)

This is the hormone produced in early pregnancy and is the basis of the urine pregnancy tests.

**Normal level < 5 mIU/mL**

**Pregnancy >25 mIU/mL**

**HCG Levels In Early Pregnancy Chart**

<u>Number Of Weeks</u>	<u>Levels Of HCG</u>
3 weeks LMP:	5 - 50 mIU/ml
4 weeks LMP:	5 - 426 mIU/ml
5 weeks LMP:	18 - 7,340 mIU/ml
6 weeks LMP:	1,080 - 56,500 mIU/ml
7 - 8 weeks LMP:	7, 650 - 229,000 mIU/ml
9 - 12 weeks LMP:	25,700 - 288,000 mIU/ml
13 - 16 weeks LMP:	13,300 - 254,000 mIU/ml
17 - 24 weeks LMP:	4,060 - 165,400 mIU/ml
25 - 40 weeks LMP:	3,640 - 117,000 mIU/ml

# AUTOIMMUNE DISEASE TESTS

Autoimmune disease are a group of disease where the body's immune system incorrectly interprets certain of its own tissues as a foreign invader and produces an immune response to attack hat tissue.





# AUTOIMMUNE DISEASE TESTS

## Rheumatoid factor

Antibodies directed against the Fc fragment of immunoglobulin G (IgG) are called rheumatoid factors (RFs). They are heterogeneous and usually composed of immunoglobulin M (IgM).

**Normal level <15 IU/mL**



## Lupus anticoagulant test

Lupus anticoagulant testing is a series of tests used to detect lupus anticoagulant (LA) in the blood. LA is an autoantibody associated with excess blood clot formation.

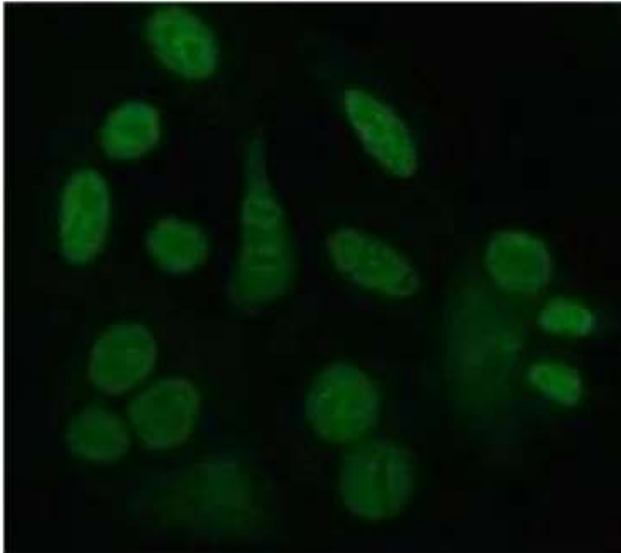
**Normal level- 20 to 39 GPL or MPL units**



# AUTOIMMUNE DISEASE TESTS

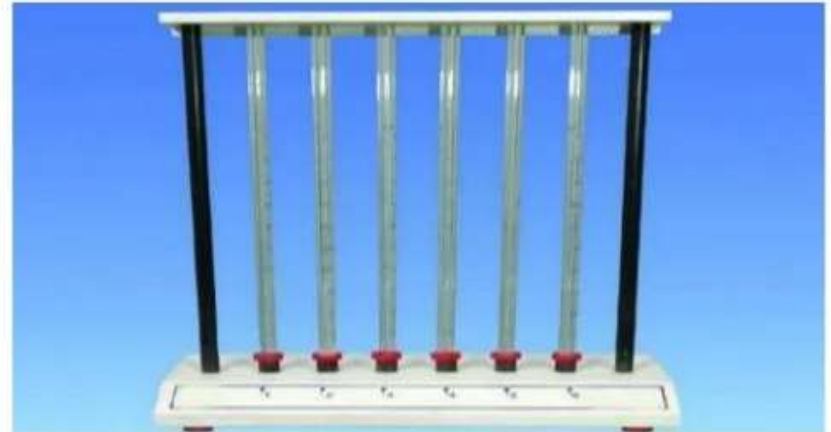
## Antinuclear antibody test

Antinuclear antibodies (ANAs) are a type of autoantibody that attacks proteins inside your cells. People with some autoimmune diseases will test positive for ANAs



## Erythrocyte sedimentation rate

An erythrocyte sedimentation rate (ESR) is a type of blood test that measures how quickly erythrocytes (red blood cells) settle at the bottom of a test tube that contains a blood sample. Normally, red blood cells settle relatively slowly. A faster-than-normal rate may indicate inflammation in the body. Inflammation may also be a sign of a chronic disease, an immune disorder, or other medical condition.



# DISEASE MARKER TESTS

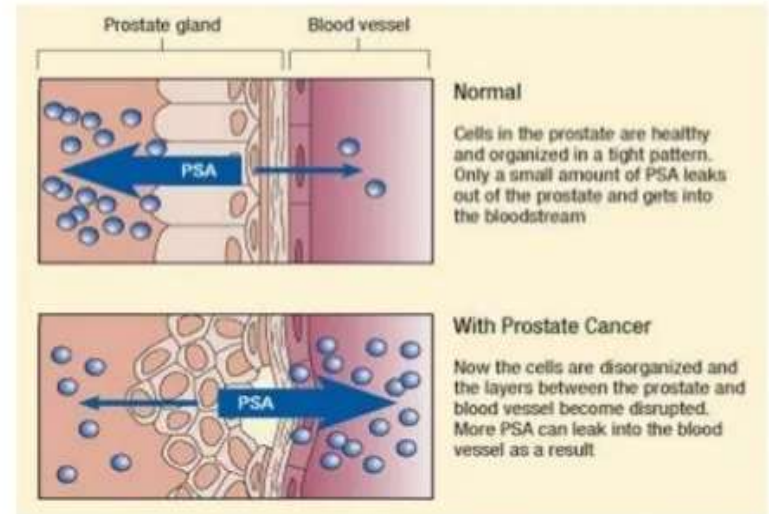
## Alpha-fetoprotein (AFP)

AFP is a major plasma protein produced by the yolk sac and the fetal liver during fetal development. Measurement of AFP is generally used in two clinical contexts.

- First, it is measured in pregnant women through the analysis of maternal blood or amniotic fluid as a screening test for certain developmental abnormalities such as aneuploidy.
- Second, serum AFP level is elevated in people with certain tumors, and so it is used as a biomarker to follow these diseases.

## Prostate-specific antigen

It is a protein produced by normal, as well as malignant, cells of the prostate gland. The PSA test measures the level of PSA in a man's blood. For this test, a blood sample is sent to a laboratory for analysis. The results are usually reported as nanograms of PSA per milliliter (ng/mL) of blood.



**THANK YOU**