

# Chapter-9

## Clinical laboratory tests used in the evaluation of disease states - significance and interpretation of test results

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### Clinical laboratory tests used in the evaluation of disease states - significance and interpretation of test results

- **Hematological, Liver function, Renal function, thyroid function tests**
- **Tests associated with cardiac disorders**
- **Fluid and electrolyte balance**
- **Pulmonary Function Tests**

### Haematological:

- Hematology (hema- is from the Greek word for 'blood') is the study of blood in regards to a person's health or disease. It includes blood, blood-forming organs, and the proteins involved in bleeding and clotting.

### Significance and interpretation of Haematological test:

- Hematological tests can evaluate numerous conditions involving blood and its components.
- They can also be used to diagnose inflammation, anemia, infection, hemophilia, blood-clotting disorders, leukemia, and response to chemotherapy, among many other things. Let's take a look at some of these tests.



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A hematology test is a blood test. Any test that requires blood or blood parts is a hematology test. These tests can offer information to a doctor about what is happening in the blood. The most common hematology tests include:

- Complete blood count (CBC) - This test counts the number of white blood cells, red blood cells, platelets, and more. This test helps to diagnose anemia, some blood cancers, inflammatory diseases, infections, and other health concerns.
- A complete blood count (CBC) measures several components and features of your blood. A CBC and its individual components are tested on whole blood. It can include measurements of the following:
  - Platelet count - This test is included in a CBC, but can also be done on its own in order to monitor clotting or bleeding disorders.
  - Prothrombin time or Partial Thromboplastin Time - These tests evaluate some blood disorders and monitor ongoing therapies.
  - International Normalized Ratio - This test monitors anticoagulation as well as blood disorders, including anemia
  - Hematology tests help to diagnose blood cancers, anemia, and disorders related to clotting, bleeding, and coagulation.

## Liver Function Test:

- Liver function tests (also known as a liver panel) are blood tests that measure different enzymes, proteins, and other substances made by the liver.
- LFTs include liver enzymes, albumin and other proteins, and bilirubin. The liver enzymes are produced by cells within the liver.
- They include alkaline phosphatase (ALP),  $\gamma$ -glutamyl transpeptidase (GGT), alanine aminotransferase (ALT) and aspartate aminotransferase (AST), but the combination of liver enzyme results you receive depends on your local laboratory.
- The protein components comprise total protein, albumin and globulin [N.B. Total protein = Albumin + Globulins].
- The globulins are a mixture of globular proteins such as immunoglobulins, enzymes, carrier proteins and complement. The LFT's reflect a limited range of hepatic metabolic processes.
- Bilirubin is an indication of the detoxification/excretory function and albumin reflects the synthetic function.

## Liver function tests are most often used to:

- Help diagnose liver diseases, such as hepatitis
- Monitor treatment of liver disease. These tests can show how well the treatment is working.
- Check how badly a liver has been damaged or scarred by disease, such as cirrhosis
- Monitor side effects of certain medicines

**Need liver function testing if you have symptoms of liver disease. These include:**



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- Jaundice, a condition that causes your skin and eyes to turn yellow
- Nausea and vomiting
- Diarrhea
- Abdominal pain
- Dark-colored urine
- Light-colored stool
- Fatigue

## Renal Function Test:

- Renal function tests (RFT) are a group of tests that may be performed together to evaluate kidney (renal) function.
- The tests measure levels of various substances, including several minerals, electrolytes, proteins, and glucose (sugar), in the blood to determine the current health of the kidneys.
- If the kidneys are not functioning properly, waste products can accumulate in the blood and fluid levels can increase to dangerous volumes, causing damage to the body or a potentially life-threatening situation. Numerous conditions and diseases can result in damage to the kidneys.
- The most common causes of and main risk factors for kidney disease are diabetes and hypertension.

**The most practical tests to assess renal function is to get an estimate of the glomerular filtration rate (GFR) and to check for proteinuria (albuminuria).**

According to the Kidney Disease Improving Global Outcomes (KDIGO), The stages of chronic kidney disease (CKD):

- Stage 1 GFR greater than 90 ml/min/1.73 m<sup>2</sup>
- Stage 2 GFR-between 60 to 89 ml/min/1.73 m<sup>2</sup>
- Stage 3a GFR 45 to 59 ml/min/1.73 m<sup>2</sup>
- Stage 3b GFR 30 to 44 ml/min/1.73 m<sup>2</sup>
- Stage 4 GFR of 15 to 29 ml/min/1.73 m<sup>2</sup>
- Stage 5-GFR less than 15 ml/min/1.73 m<sup>2</sup> (end-stage renal disease)

## Thyroid Function Test:

- Thyroid function tests are blood tests which help to check the function of your thyroid gland.
- They are mainly used to detect an underactive thyroid gland (hypothyroidism) and an overactive thyroid gland (hyperthyroidism).
- The two hormones, thyroxine (T4) and thyroid-stimulating hormone (TSH), work together and are usually in balance



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## Normal range

The following are approximate values for what is normal for TSH and thyroxine levels. These are a rough guide only and will vary from hospital to hospital.

- Normal range for thyroid-stimulating hormone: 0.4-4.0 mU/L.
- Normal range for thyroxine: 9-24 pmol/L.
- So in general if SH is low and thyroxine level is high, you may have an overactive thyroid gland.
- Conversely if TSH is high and thyroxine level is low, you may have an underactive thyroid gland.
- There are other options such as having a high TSH but a normal thyroxine and that can indicate something called subclinical hypothyroidism.

## Tests associated with cardiac disorders:

Many different tests are used to diagnose heart disease. Besides blood tests and a chest X-ray, tests to diagnose heart disease can include:

1. **Electrocardiogram (ECG or EKG):** This test measures the electrical activity of the heart and can detect abnormal heart rhythms, damage to the heart muscle, and other problems.
2. **Echocardiogram:** This is an ultrasound test that uses sound waves to create images of the heart. It can be used to evaluate the size and shape of the heart, the thickness of the heart muscle, and the function of the heart valves.
3. **Stress test:** This test involves exercising the heart to see how it responds. It can be done on a treadmill or with medication. It can be used to detect problems with blood flow to the heart or abnormal heart rhythms.
4. **Cardiac catheterization:** This test involves inserting a thin, flexible tube (catheter) into a blood vessel in the arm or leg and guiding it to the heart. It can be used to diagnose blockages in the coronary arteries or to measure pressures within the heart.
5. **Holter monitor:** This is a portable device that records the heart's electrical activity over a period of 24-48 hours. It can be used to detect abnormal heart rhythms that may not show up on a regular ECG.
6. **Cardiac MRI:** This test uses a powerful magnetic field and radio waves to create detailed images of the heart. It can be used to evaluate the size and function of the heart and to detect problems such as blockages or damage to the heart muscle.
7. **CT scan:** This test uses X-rays to create detailed images of the heart and blood vessels. It can be used to detect blockages in the coronary arteries or to evaluate the size and function of the heart.



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## Fluid and electrolyte balance:

Electrolytes are minerals in your body that have an electric charge. They are in your blood, urine, tissues, and other body fluids. Electrolytes are important because they help:

- Balance the amount of water in your body
  - Balance your body's acid/base (pH) level
  - Move nutrients into your cells
  - Move wastes out of your cells
  - Make sure that your nerves, muscles, the heart, and the brain work the way they should
- Sodium, calcium, potassium, chloride, phosphate, and magnesium are all electrolytes. You get them from the foods you eat and the fluids you drink.

The levels of electrolytes in your body can become too low or too high. This can happen when the amount of water in your body changes.

The amount of water that you take in should equal the amount you lose. If something upsets this balance, you may have too little water (dehydration) or too much water (overhydration). Some medicines, vomiting, diarrhea, sweating, and liver or kidney problems can all upset your water balance.

Treatment helps you to manage the imbalance. It also involves identifying and treating what caused the imbalance.

## Pulmonary Function Tests:

Pulmonary Function Tests (PFTs) are a group of diagnostic tests used to evaluate the function of the lungs. These tests can help diagnose a range of respiratory conditions and can help monitor the progression of lung disease.

The most common types of PFTs include:

1. **Spirometry:** This test measures the amount of air a person can inhale and exhale, and how quickly they can do it. It can help diagnose conditions such as asthma and chronic obstructive pulmonary disease (COPD).
2. **Lung volume measurements:** These tests measure the amount of air in the lungs, both when they are full and when they are empty. They can help diagnose conditions such as interstitial lung disease and sarcoidosis.
3. **Diffusion capacity:** This test measures how easily oxygen passes from the lungs into the bloodstream. It can help diagnose conditions such as pulmonary fibrosis and emphysema.
4. **Exercise testing:** This test measures how well the lungs function during physical activity. It can help diagnose conditions such as exercise-induced asthma and evaluate the effectiveness of treatments.

