



X-Plain Blood and Bone Marrow Basics Reference Summary

Introduction

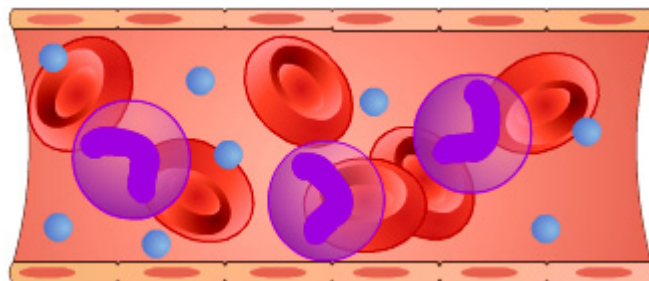
Blood helps distribute the nutrients, oxygen, and hormones the body needs. It also carries toxins and waste materials to the liver and kidneys to be removed from your body.

If your doctor finds something abnormal about your blood, he may ask you to get a variety of blood tests. These tests help your doctor understand what may be causing the problem. Your doctor may also ask you to repeat certain blood tests on a regular basis to see if anything is changing in your blood cell counts.

This reference summary gives basic information about blood, blood tests, and bone marrow tests. It first explains the different types of blood cells and how they are made. It then discusses some of the different types of blood tests and bone marrow tests you might get.

Blood Composition

Blood is made of blood cells floating in plasma. Plasma is mostly made of water with chemicals in it. These chemicals include sugar, which is called glucose, cholesterol, proteins, hormones, minerals, and vitamins.

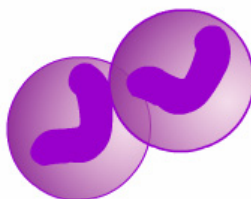


Blood

There are three basic types of blood cells: Red blood cells, white blood cells, and platelets.



Red Blood Cells



White Blood Cells



Platelets

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Red blood cells are also called erythrocytes. They make up almost half of blood. Red blood cells are filled with hemoglobin. That's a protein that picks up oxygen in the lungs and delivers it to cells all around the body. They also pick up carbon dioxide, or CO₂, from the cells to be breathed out from the lungs.

White blood cells are also called leukocytes. They fight disease and infection by attacking and killing germs that get into the body. There are several kinds of white blood cells. Each kind fights different kinds of germs in different ways.

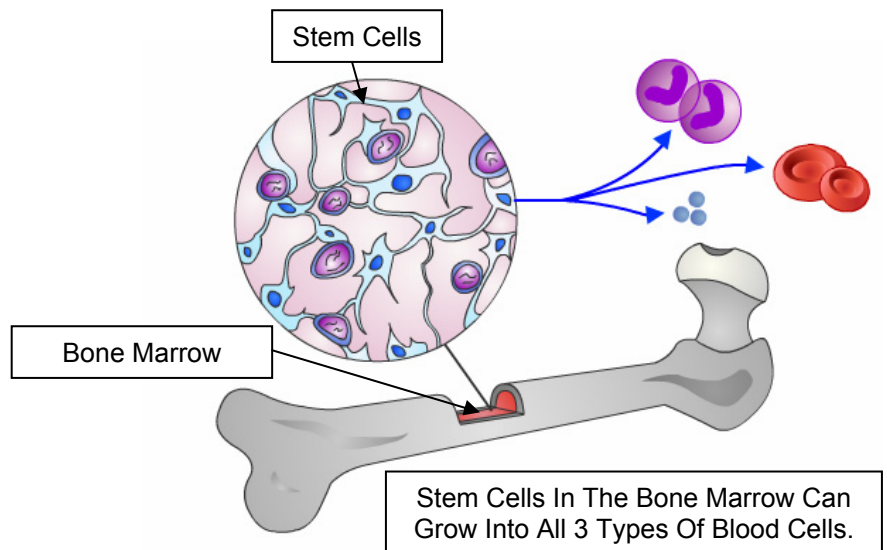
Platelets are also called thrombocytes. They are small pieces of cell that help blood clot and stop bleeding.

Blood Formation

Blood cells are made in the bone marrow. The bone marrow is a spongy tissue located inside some bones. It contains young parent cells called stem cells.

Stem cells can grow into all 3 types of blood cells. They make copies or clones of themselves all the time. These cloned stem cells eventually become mature blood cells.

When blood cells are fully formed and functional, they leave the bone marrow and enter the blood. Healthy people have enough stem cells to keep making all the blood cells the body needs every day.



If you don't have enough of one type of blood cell, this is called a low blood count. Doctors also call this a cytopenia.

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A low red blood cell count is called anemia. The most common symptom of anemia is fatigue or tiredness. Other symptoms may include:

- Shortness of breath
- Appearing pale
- Feeling the heart beat
- Headaches
- Ringing or humming in the ears
- Increased sleepiness
- Lightheadedness
- Coldness in the hands and feet



The more severe the anemia and the more quickly it develops, the worse the symptoms tend to be. Many other problems can cause these symptoms too, so doctors must perform tests to figure out if the symptoms are related to anemia.

A low white blood cell count is called leucopenia. There are many different types of white blood cells. Each of them protects you from different types of infections. Neutrophils are the most common type of white cell. They are also the most important cells for attacking and killing bacteria. A low neutrophil count is called neutropenia.

If you have a very low white blood cell count, you are more likely to develop infections. These may include:

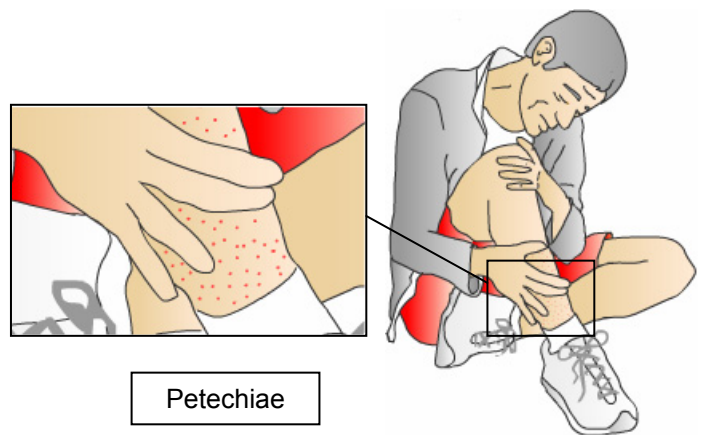
- Bladder infections that may make it painful to urinate or make you urinate more often
- Lung infections that may make breathing hard
- Mouth sores
- Sinus infections and a stuffy nose
- Skin infections

A low platelet count is called thrombocytopenia. If you have a very low platelet count, you may bruise and bleed more easily, even from minor scrapes and bumps.

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Other symptoms may include:

- Nose bleeds.
- Tiny, flat red spots under your skin called petechiae. These occur more often in the lower legs.
- Bleeding gums. This often happens after dental work or from brushing your teeth.



CBC Blood Test

One important test doctors usually order is the complete blood count or CBC. A CBC measures the number of each blood cell type in your blood sample.

If the CBC shows a low number of red blood cells, white blood cells, or platelets, your doctor may look at the cells under a microscope. This is called a blood smear. It lets your doctor take a close look at the shape and size of your blood cells.



A CBC usually includes the following tests:

- White blood cell count (WBC)
- White blood cell differential
- Red blood cell count (RBC)
- Hemoglobin (Hgb)
- Hematocrit (Hct)
- Platelet count
- Mean corpuscular volume (MCV)
- Red cell distribution width (RDW)

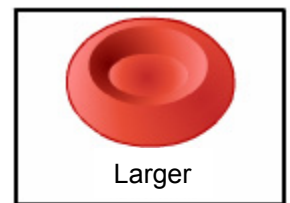
These are discussed next in more detail.

- White blood cell count (WBC) measures the actual number of white blood cells in a given volume of blood. If you have a low white blood cell count you may have an increased risk of getting an infection. The normal range for a person is 4.5 to 10 thousand cells/mcL.
- White blood cell differential looks at the types of white blood cells in your blood. There are many different types of white blood cells. Each of them has a different purpose and protects you from different types of infections.

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- Red blood cell count (RBC) measures the actual number of red blood cells in a given volume of blood. A low red blood cell count is called anemia. The normal range for men is 4.4 to 5.8 million cells/mcL. The normal range for women is 3.9 to 5.2 million cells/mcL. This can vary if you are living in high altitudes like mountain areas.
- Hemoglobin (Hgb) measures the amount of this oxygen-carrying protein in red blood cells. This level is low in people with anemia. The normal range for men is 13.8 to 17.2 grams/dL. The normal range for women is 12.0 to 15.6 grams/dL.
- Hematocrit (Hct) measures how much of a given volume of whole blood is made up of red blood cells. In healthy men, 41 percent to 50 percent of blood is red blood cells. In healthy women, 35 percent to 46 percent is red blood cells. If you have anemia, your hematocrit, along with your red blood cell count and hemoglobin, will usually all be low.
- Platelet count measures the number of platelets in a given volume of blood. A low count means you may have an increased risk of bleeding and bruising if you get cut or injured. The normal range of platelets is 150 to 450 thousand/mcL.
- Mean corpuscular volume (MCV) measures the average size of red blood cells. It is high when red blood cells are larger than normal. It is low when red blood cells are smaller than normal. The normal range for MCV is 80 to 100 cu mcM.

If you have anemia, the size of the red blood cells may alert your doctor to the possible cause. For example, if your red blood cells are larger than normal (macrocytic anemia) it may be related to alcohol use, medications, increased production of red blood cells, low thyroid, vitamin deficiencies, or a bone marrow problem.



If your red blood cells are smaller than normal (microcytic anemia) it may be related to low iron, inherited anemia, the presence of another illness, or certain rare bone marrow problems.



Red cell distribution width (RDW) measures differences in the size of your red blood cells. If your red cells vary a lot in size, this can be a sign of a problem.



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Other Blood Tests

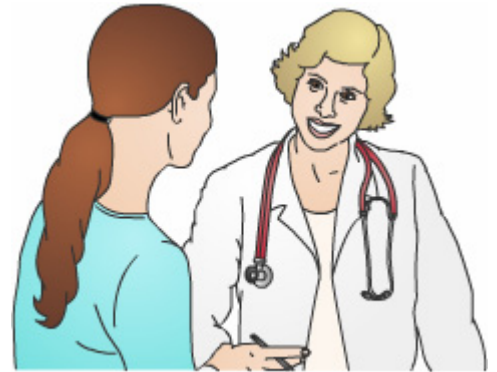
Anemia, the most common type of low blood count, can be caused by many things. If your CBC shows that you have anemia, a doctor will usually order other blood tests to find out the cause of the anemia.

The most common cause of anemia is a shortage of iron in the body. If the body has no iron stores, it will have difficulty making new red blood cells. Other common causes of anemia include:

- Bleeding (which often leads to low iron stores)
- Kidney disease
- Certain chronic diseases
- Excessive alcohol use
- Vitamin deficiencies

Some of the tests a doctor may order to find the cause of your anemia include:

- Iron level tests including serum iron, total iron binding capacity, and serum ferritin
- Serum creatinine
- Vitamin B12 level
- Folate level
- Erythropoietin or EPO level



Many tests are used to measure iron stores in your body. The most common tests are serum iron, total iron binding capacity, and serum ferritin. Low iron levels in your body can cause red blood cells to be smaller than normal and lead to reduced oxygen carrying capacity.

A serum creatinine level test tells your doctor how well your kidneys are functioning. Kidneys play an important role in red blood cell production.

Vitamin B12 and folic acid level tests tell the doctor how much of these vitamins are in your blood to help make blood cells. A shortage of these vitamins can cause red blood cells to be larger than normal and can lead to anemia.

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An EPO level test measures the amount of the hormone erythropoietin, or EPO, in the blood. EPO is a hormone secreted by the kidneys. It stimulates the formation of red blood cells in the bone marrow.

Bone Marrow Tests

Bone marrow is the spongy tissue inside some of your bones.

A bone marrow test usually involves two procedures: an aspiration and a biopsy. Bone marrow is usually taken from the back of the hip bone. The hip is a safe place to take bone marrow from and hip bones have a lot of bone marrow in them.

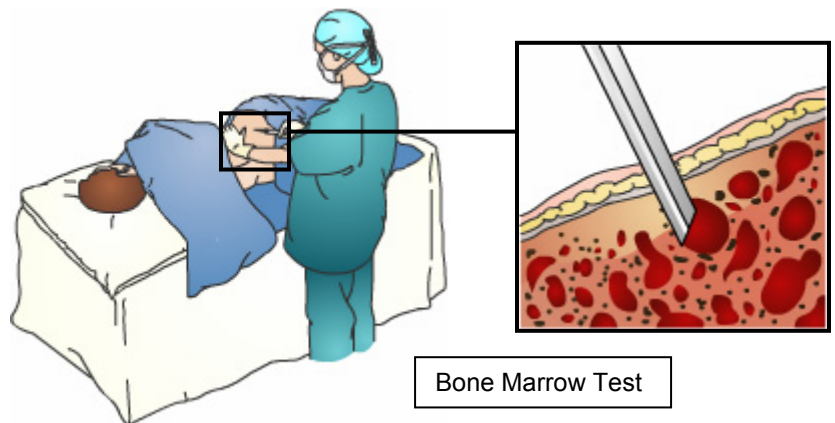
An aspiration removes liquid bone marrow with a syringe. The aspirate is put on slides and examined under a microscope. Special studies can then be done on the liquid bone marrow.

A biopsy takes a small sample of the bone which contains bone marrow.

A doctor may order a bone marrow test for certain blood diseases and for some types of anemia. For example, a bone marrow test may be ordered if a person has normal blood cell counts, but a closer examination of blood cells shows that some cells have an abnormal shape or size.

You should always tell your doctor prior to getting a bone marrow test if you are pregnant, are taking any blood-thinning medication, or have bleeding problems. Also tell you doctor if you are taking aspirin. Make sure your healthcare team knows if you are allergic to any medication.

Bone marrow tests can be done in the hospital or at the doctor's office. First, the doctor cleans the area. The doctor then injects a local anesthetic to numb the skin and the bone under the skin. A special needle is then inserted. Liquid bone marrow aspirate and a biopsy sample are taken. Doctors do not usually put patients to sleep during this procedure.



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The bone marrow sample is sent to another doctor called a pathologist, who examines the bone marrow and looks for abnormalities.

Using special tools and tests, the pathologist can see exactly what types and amounts of cells your marrow is making. The pathologist can also tell if there are:

- Cells with an abnormal shape, size, or look
- Increased, decreased, or normal levels of iron in your bone marrow
- Red blood cells that contain ring-shaped iron deposits called ring sideroblasts. Ring sideroblasts are very young red blood cells that have ring-shaped iron deposits in them.
- Too many immature white blood cells, also called blasts, in your marrow. Blasts are the youngest or most immature white blood cells. In normal bone marrow, no more than 5 out of 100 white cells are blasts.
- Chromosomal abnormalities in the cells in your bone marrow



When your doctor receives the results, he or she will inform you.

Conclusion

There are many blood tests that can help your doctor and healthcare providers diagnose and treat you better.

Understanding the different types of cells in our blood and their function helps you better understand the purpose and results of blood tests.



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