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BLOOD DISORDERS

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ABSTRACT

The whole blood which is a mixture of cells, colloids and crystalloids can be separated into different blood components namely packed red blood cell concentrate, platelet concentrate, fresh frozen plasma and cryoprecipitate. Each blood component is used for a different indication; thus the component separation has maximized the utility of one whole blood unit. Different components need different storage conditions and temperature requirements for therapeutic efficacy. A variety of equipments to maintain suitable ambient conditions during storage and transportation are in vogue. The blood components being foreign to a patient may produce adverse effects that may range from mild allergic manifestations to fatal reactions. Such reactions are usually caused by plasma proteins, leucocytes, red cell antigens, plasma and other pathogens. To avoid and reduce such complications, blood products are modified as leukoreduced products, irradiated products, volume reduced products, saline washed products and pathogen inactivated products. The maintenance of blood inventory forms a major concern of blood banking particularly of rare blood groups routinely and common blood groups during disasters. PRBCs can be stored for years using cryopreservation techniques. New researches in red cell cultures and.

INTRODUCTION

Blood is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells.

Blood disorders and any disease of the blood, involving the red blood cells, white blood cells, or platelets or the tissues in which these elements are formed the bone marrow, lymph nodes, and spleen or of bleeding and blood clotting.

In vertebrates, it is composed of blood cells suspended in blood plasma. Plasma, which constitutes 55% of blood fluid, is mostly water volume and contains proteins, glucose, mineral ions, hormones, carbon dioxide plasma being the main medium for excretory product transportation, and blood cells themselves.

Albumin is the main protein in plasma, and it functions to regulate the colloidal osmotic pressure of blood. The blood cells are mainly red blood cells, white blood cells and platelets. The most abundant cells in vertebrate blood are red blood cells. These contain haemoglobin, an iron-containing protein, which facilitates oxygen transport by reversibly binding to this respiratory gas and greatly increasing its solubility in blood. In contrast, carbon dioxide is mostly transported extracellularly as bicarbonate ion transported in plasma.

Vertebrate blood is bright red when its hemoglobin is oxygenated and dark red when it is deoxygenated. Some animals, such as crustaceans and mollusks, use hemocyanin to carry oxygen, instead of hemoglobin. Insects and some mollusks use a fluid called hemolymph instead of blood, the difference being that hemolymph is not contained in a closed circulatory system. In most insects, this "blood" does not contain oxygen-carrying molecules such as hemoglobin because their bodies are small enough for their tracheal system to suffice for supplying oxygen.

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Compopsition of blood

The components of human blood are

- **Plasma**

The liquid component of the blood in which the following blood cells

- **Red blood cells** (erythrocytes).

These carry oxygen from the lungs to the rest of the body

- **White blood cells** (leukocytes).

These help fight infections and aid in the immune process.

Types of white blood cells include

- Lymphocytes
- Monocytes
- Eosinophils
- Basophils
- Neutrophils

- **Platelets** (thrombocytes).

These help in blood clotting.

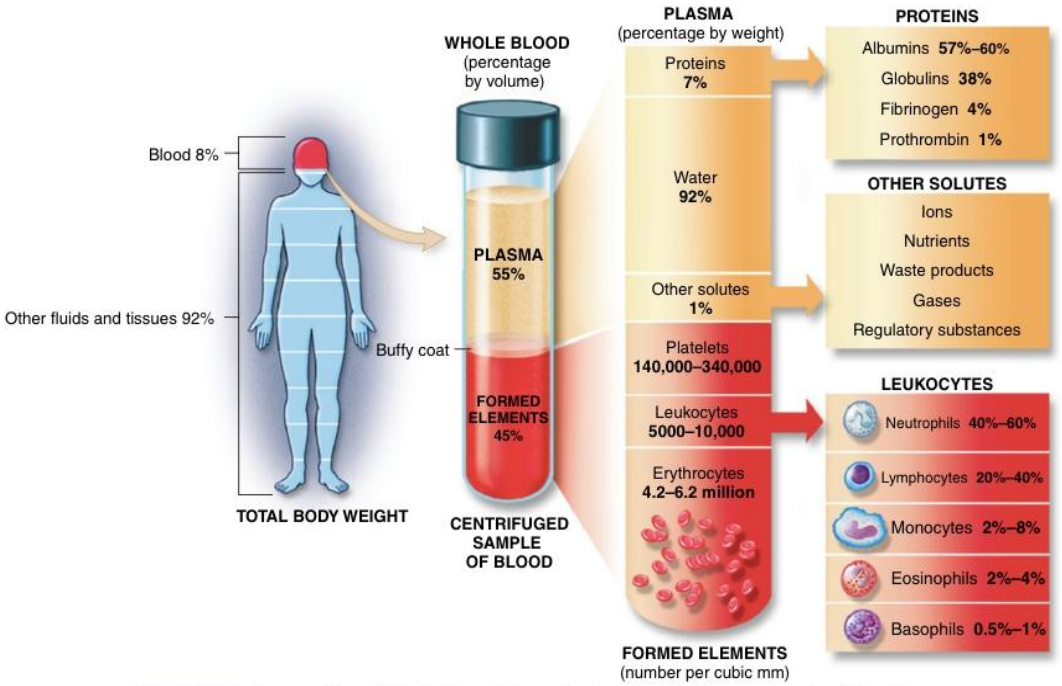


FIGURE 19-1 Composition of Whole Blood. Approximate values for the components of blood in a normal adult. (From Patton KT, Thibodeau GA: *Anatomy & Physiology,* ed 7, St Louis, 2010, Mosby.)

Fig: Composition of blood.

Function of blood

The primary function of blood is to deliver oxygen and nutrients to, and remove wastes from, the body cells; but that is only the beginning of the story.

The specific functions of blood also include defense, distribution of heat, and maintenance of homeostasis.

1) Transportation

Nutrients from the foods you eat are absorbed in the digestive tract. Most of these travel in the bloodstream directly to the liver, where they are processed and released back into the bloodstream for delivery to body cells. Oxygen from the air you breathe diffuses into the blood, which moves from the lungs to the heart, which then pumps it to the rest of the body.

Moreover, endocrine glands scattered throughout the body release hormones into the bloodstream, which carries them to distant target cells. Blood also picks up cellular wastes and byproducts, and transports them to various organs for removal.

For instance, blood moves carbon dioxide to the lungs for exhalation from the body, and various waste products are transported to the kidneys and liver for excretion from the body in the form of urine or bile.

2) Defense

Many types of WBCs protect the body from external threats, such as disease-causing bacteria that have entered the bloodstream in a wound. Other WBCs seek out and destroy internal threats, such as cells with mutated DNA that could multiply to become cancerous, or body cells infected with viruses.

When damage to the vessels results in bleeding, blood platelets and certain proteins dissolved in the plasma, interact to create clots which block the ruptured areas of the blood vessels involved. This protects the body from further blood loss.

3) Maintenance of homeostasis

Recall that body temperature is regulated via a negative-feedback loop. If you were exercising on a warm day, your rising core body temperature would trigger several homeostatic mechanisms, including increased transport of blood from your core to your body periphery, which is typically cooler. As blood passes through the vessels of the skin, heat would be dissipated to the environment, and the blood returning to your body core would be

cooler. In contrast, on a cold day, blood is diverted away from the skin to maintain a warmer body core. In extreme cases, this may result in frostbite.

Blood also helps to maintain the chemical balance of the body. Proteins and other compounds in blood act as buffers, which help to regulate thepH of body tissues. Blood also helps to regulate the water content of body cells.

4) Supply of oxygen to tissues.
5) Supply of nutrients Such as, Glucose, Amino acid, Fatty acids.
6) Removal of waste such as carbon dioxide, urea, and lactic acid.
7) Immunological function such as, Circulations of White blood cells (WBC), and detection of foreign materials by Antibodies.
8) Thermoregulation: Regulation of body temperature.
9) Transport of hormones and the signalling of tissue damage.

Disorders of blood

Disorders of Blood are classified as various types which are as follows;

- **Erythrocytes (RBC) disorders**

- Anaemia
- Iron deficiency anaemia
- Anaemia of chronic diseases
- Aplastic anaemia
- Autoimmune anaemia
- Thalassemia
- Sickle cell anaemia
- Mlaria

- **Leukocytes (WBC) disorders**

- Lymphoma
- Hodgkins diseases
- Luekemia
- Multiple myeloma

- **Platelets disorders**

- Thrombocytopenia
- Idiopathic thrombocytopenic purpura

- Heparin induced thrombocytopenia

- **Blood plasma**
- Heamophellia

Erythrocytes (RBC) disorders

Anemia

Anemia is defined as a low number of red blood cells. In a routine blood test, anemia is reported as a low hemoglobin or hematocrit. Hemoglobin is the main protein in your red blood cells. It carries oxygen, and delivers it throughout your body. If you have anemia, your hemoglobin level will be low too. If it is low enough, your tissues or organs may not get enough oxygen.

Symptoms of anemia like fatigue or shortness of breath happen because your organs aren't getting what they need to work the way they should. Anemia is the most common blood condition in the U.S. It affects almost 6% of the population. Women, young children, and people with long-term diseases are more likely to have anemia. Important things to remember are:

Certain forms of anemia are passed down through your genes, and infants may have it from birth.

Women are at risk of iron-deficiency anemia because of blood loss from their periods and higher blood supply demands during pregnancy.

Older adults have a greater risk of anemia because they are more likely to have kidney disease or other chronic medical conditions

Anemia Types and Causes

There are more than 400 types of anemia, and they’re divided into three groups:

Anemia caused by blood loss.

Anemia caused by decreased or faulty red blood cell production.

Anemia caused by destruction of red blood cells.

Anemia caused by blood loss

You can lose red blood cells through bleeding. This can happen slowly over a long period of time, and you might not notice.

- Gastrointestinal conditions such as ulcers, hemorrhoids, gastritis inflammation of your stomach, and cancer
- Non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen, which can cause ulcers and gastritis
- A woman's period, especially if you have a heavy menstruation (or heavy period). This can be associated with fibroids.
- Post-trauma or post-surgery as well.

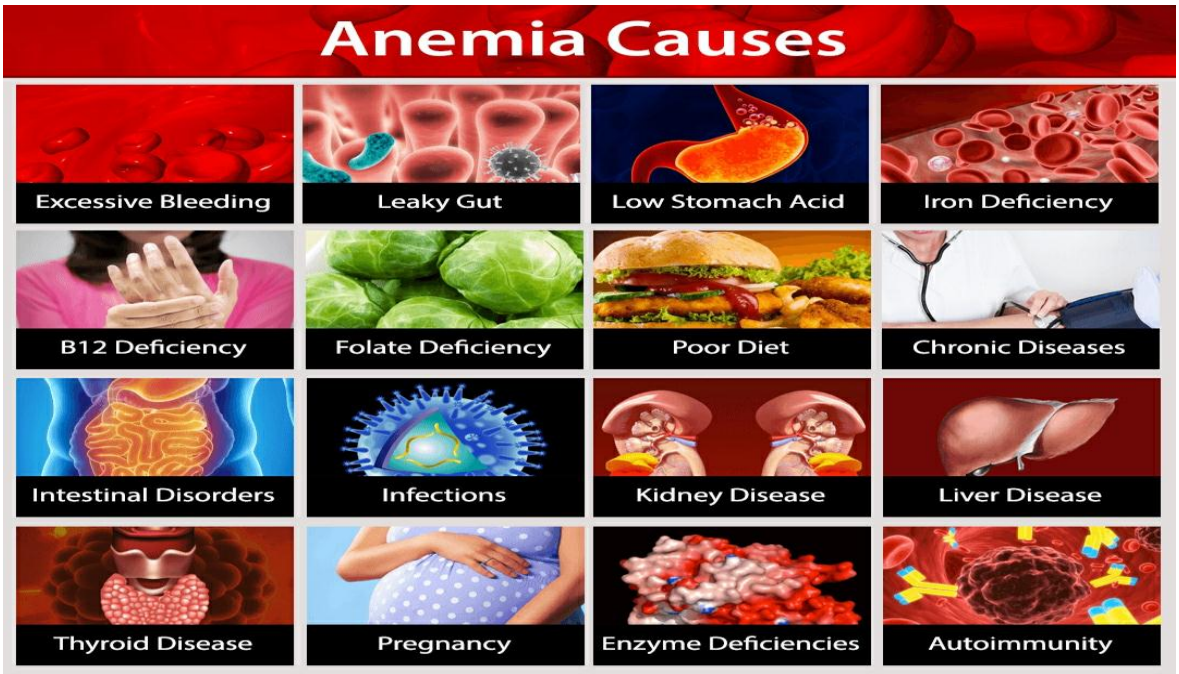


Fig: Causes of anemia.

Caused by decreased or faulty red blood cell production

With this type of anemia, your body may not create enough blood cells, or they may not work the way they should. This can happen because there's something wrong with your red blood cells or because you don't have enough minerals and vitamins for your red blood cells to form normally.

- Bone marrow and stem cell problems
- Iron-deficiency anemia
- Sickle cell anemia
- Vitamin-deficiency anemia, specifically b12 or folat

Iron-deficiency anemia

Happens because you don't have enough of the mineral iron in your body. Your bone marrow needs iron to make hemoglobin, the part of the red blood cell that takes oxygen to your organs. Iron-deficiency anemia can be caused by:

- A diet without enough iron, especially in infants, children, teens, vegans, and vegetarians
- Certain drugs, foods, and caffeinated drinks
- Digestive conditions such as Crohn's disease, or if you've had part of your stomach or small intestine removed
- Donating blood often
- Endurance training
- Pregnancy and breastfeeding using up iron in your body
- A common cause is chronic slow bleed, usually from a Gastrointestinal source

Sickle cell anemia

Is a disorder that, in the U.S., affects mainly African Americans and Hispanic Americans. Your red blood cells, which are usually round, become crescent-shaped because of a problem in your genes.

Anemia results when the red blood cells break down quickly, so oxygen doesn't get to your organs. The crescent-shaped red blood cells can also get stuck in tiny blood vessels and cause pain.

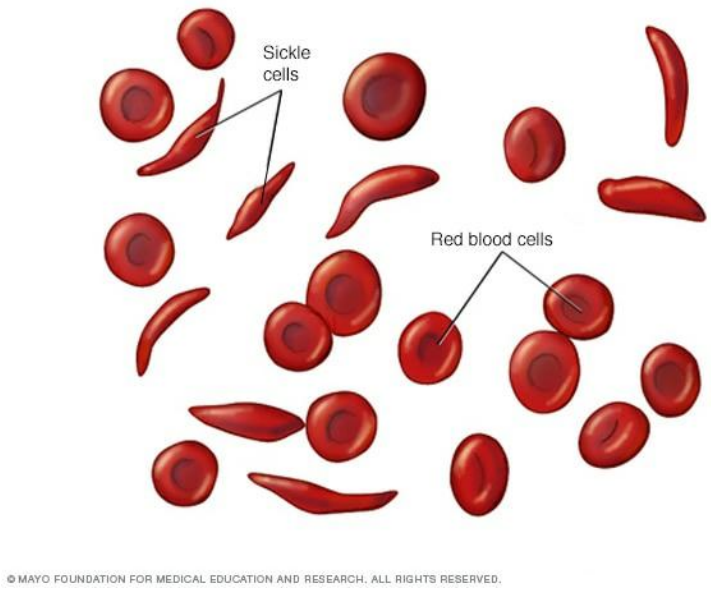


Fig: Sickle cell anemia cells.

Vitamin-deficiency anemia

It can happen when you aren't getting enough vitamin B12 and folate. You need these two vitamins to make red blood cells. This kind of anemia can be caused by:

- **Dietary deficiency:** If you eat little or no meat, you might not get enough vitamin B12. If you overcook vegetables or don't eat enough of them, you might not get enough folate.
- **Megaloblastic anemia:** When you don't get enough vitamin B12, folate, or both
- **Pernicious anemia:** When your body doesn't absorb enough vitamin B12

Anemia associated with other chronic conditions

It usually happens when your body doesn't have enough hormones to make red blood cells. Conditions that cause this type of anemia include:

- Advanced kidney disease
- Hypothyroidism
- Old age
- Long-term diseases, such as cancer, infection, lupus, diabetes, and rheumatoid arthritis

Sign and Symptoms

The signs of anemia can be so mild that you might not even notice them. At a certain point, as your blood cells decrease, symptoms often develop. Depending on the cause of the anemia, symptoms may include:

- Dizziness, light headness , or feeling like you are about to pass out
- Fast or unusual heartbeat
- Headache
- Pain, including in your bones, chest, belly, and joints
- Problems with growth, for children and teens
- Shortness of breath
- Skin that's pale or yellow
- Cold hands and feet
- Tiredness or weakness

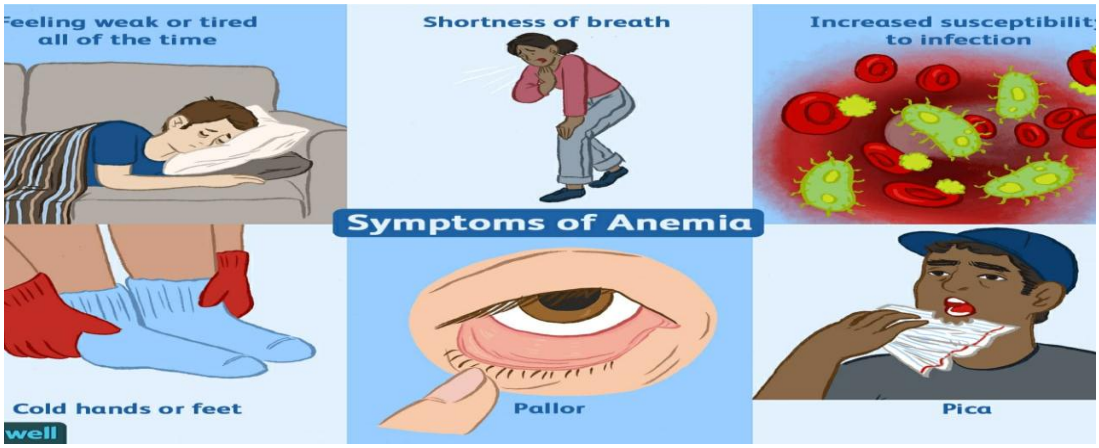


Fig: Symptoms of anemia.

Treatment

Treatment of anemia may depend on what type of anemia the patient has.

- **Iron deficiency anemia treatment**

This usually involves taking iron supplements to replace the lack of intake of iron in diet or excess loss of iron.

The most commonly prescribed supplement is ferrous sulphate. It is taken as pills two or three times a day.

Oral iron preparations come with a host of side effects that include nausea, vomiting, abdominal pain, heartburn, constipation, diarrhea, black stool and blackening of teeth, gums and tongue.

Taking ferrous sulphate along with food or shortly after eating helps to reduce the side effects.

Another alternative is ferrous gluconate.

Iron can be replaced by taking diet rich in iron. This includes dark-green leafy vegetables, iron-fortified bread and cereal, beans, meat, nuts, apricots, prunes, raisins, dates etc.

Tea, coffee, calcium, found in dairy products such as milk, antacids etc. reduce the iron absorption from the gut and should be avoided.

Vitamin C supplements helps absorb iron better. Patient is checked up after two to four weeks to see if there is a response**.**

- **Vitamin B12 deficiency anaemia treatment**

This can be treated by injections of vitamin B12. The vitamin is in the form of a substance known as hydroxocobalamine. The injections are given on alternate days for two weeks.

If there is a dietary lack of the vitamin, tablets may be prescribed. Vitamin B12 can be found in meat, milk, eggs, salmon etc.

Vegetarians or vegans may need supplementation as tablets or fortified cereals or soy products.

- **Anemia due to folate deficiency**

For folate deficiency anemia daily folic acid tablets are prescribed.

Folate tablets are usually prescribed along with Vitamin B12 supplements. This is because folic acid treatment can sometimes improve the symptoms masking an underlying vitamin B12 deficiency.

If a vitamin B12 deficiency is not detected and treated at this stage there could be severe damage to the brain, nerves and spinal cord due to vitamin B12 deficiency.

Folate is found in broccoli, green cabbage, wheatgerm, pulses, nuts, green leafy vegetables etc.

- **Treatment for severe anemia**

Researchers report a liquid biopsy for COVID-19
Intravenous iron therapy does not benefit anemic patients during surgery, study finds
Correlations found between 'long-COVID' patients and preexisting health conditions
When the anaemia is more severe, a blood transfusion is often necessary.

- **Sickle cell anemia treatment**

Patients with sickle cell anemia need a healthy diet, supplements of folic acid, vitamin D and zinc and avoid triggers for crises.

This includes smoking, alcohol, overexertion, dehydration, cold and hot temperatures, constricting clothes etc.

There is no cure for sickle cell anaemia, but the frequency and severity of crises and their complications can be reduced.

They need complete vaccinations against flu, pneumococcus meningitis, Hepatitis B and other diseases to prevent infections.

- **Anemia due to infection**

Anemia caused by an infection will usually improve when the infection is treated. This is especially true for newborns with severe infections called sepsis.

- **Anemia in pregnancy**

If the hemoglobin concentration is less than 9.0 g per dLanemia in pregnancy is diagnosed. Anemia is managed with oral dose of 60 to 120 mg per day of iron. Patient is evaluated after four weeks of therapy.

- **Anemia and bone marrow treatment**

Some medications are prescribed to stimulate the bone marrow to produce more RBCs. This is useful in aplastic anemia and leukemias.

Bone marrow transplantation may also be used. In this procedure, bone marrow cells taken from a matching donor match.

Prevention

In infants and preschool children anemia can be prevented by encouraging exclusive breast feeding of infants for four to six months after birth.

During weaning from the breast to solids additional source of iron should be introduced in supplementary foods. If the infant is not breast fed, only an iron-fortified formula as a substitute for breast milk is recommended.

In breast fed infants who have iron deficient diet 1 mg per kg per day of iron drops are recommended if not supplemented in other foods.

Since milk hampers the absorption of iron from gut, it should be suggested that children aged one to five years need no more than 24 oz of cow's milk, goat's milk and soy milk per day.

Foods rich in vitamin C (e.g., fruits, vegetables and juice) are recommended beyond six months to increase iron absorption.

For adolescent girls and women prevention of iron deficiency includes a healthy iron rich diet. All adolescent girls and nonpregnant women need to be screened for anemia every five to 10 years until menopause.

In pregnancy oral low-dose (30 mg per day) supplements of iron at the first prenatal visit may be started to prevent anemia.
Pregnant women are encouraged to eat iron-rich foods and foods that enhance iron absorption.

Leucocytes (WBC) disorders

Leukemia

Leukemia is the general term for some different types of blood cancer.
There are four main types of leukemia called:
Acute lymphoblastic (lymphocytic) leukemia
Acute myeloid (myelogenous) leukemia
Chronic lymphocytic leukemia
Chronic myeloid (myelogenous) leukemia.

It is important to know that patients are affected and treated differently for each type of leukemia. These four types of leukemia do have one thing in common they begin in a cell in the bone marrow. The cell undergoes a change and becomes a type of leukemia cell.

The marrow has two main jobs. The first job is to form myeloid cells. Myeloid leukemia can begin in these cells. The second job is to form lymphocytes, which are a part of the immune system.

The leukemia is called lymphocytic or lymphoblastic if the cancerous change takes place in a type of marrow cell that forms lymphocytes. The leukemia is called myelogenous or myeloid if the cell change takes place in a type of marrow cell that normally goes on to form red cells, some kinds of white cells and platelets.

For each type of leukemia, patients are affected and treated differently. ALL and AML (acute leukemias) are each composed of young cells, known as lymphoblasts or myeloblasts. These cells are sometimes called blasts. Acute leukemias progress rapidly without treatment.

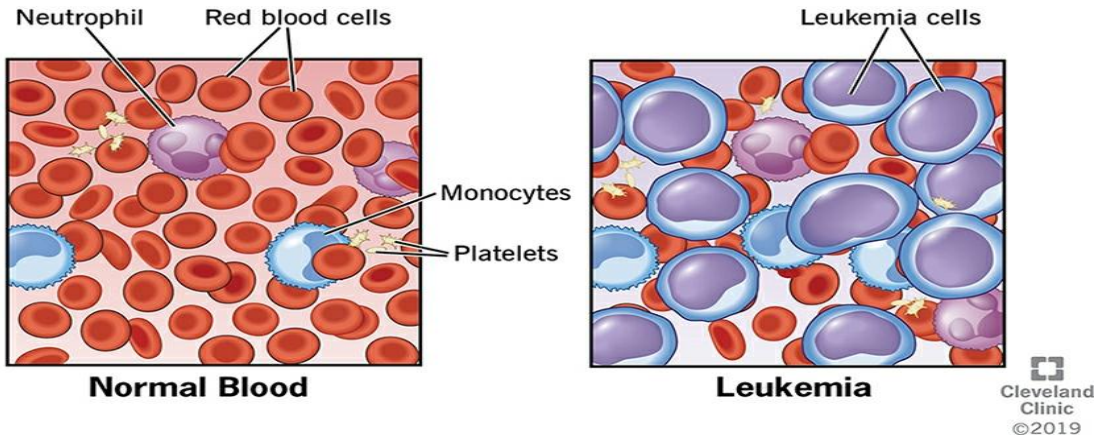


Fig: Leukemia cells.

Signs and Symptoms

Some signs or symptoms of leukemia are similar to other more common and less severe illnesses. Specific blood tests and bone marrow tests are needed to make a diagnosis.

Signs and symptoms vary based on the type of leukemia. For acute leukemia, they include:

- Tiredness or no energy
- Shortness of breath during physical activity
- Pale skin
- Mild fever or night sweats
- Slow healing of cuts and excess bleeding
- Black-and-blue marks (bruises) for no clear reason
- Pinhead-size red spots under the skin
- Aches in bones or joints (for example, knees, hips or shoulders)
- Low white cell counts, especially monocytes or neutrophils.
- Extreme tiredness
- Hair loss
- -Changes to blood counts
- Upset stomach
- Mouth sores
- Diarrhea.

Treatment

It is important to get medical care at a center where doctors are experienced in treating patients with leukemia. The aim of leukemia treatment is to bring about a complete remission. This means that after treatment, there is no sign of the disease and the patient returns to good health. Today, more and more leukemia patients are in complete remission at least five years after treatment.

Acute Leukemia. Treatment for patients with acute leukemia may include chemotherapy, stem cell transplantation or new approaches under study (clinical trials). Speak to your doctor to find out what treatment is best for you.

Patients with an acute leukemiaacute lymphoblastic leukemiaand acute myeloid leukemia need to start treatment soon after diagnosis.

Usually, they begin treatment with chemotherapy, which is often given in the hospital. The first part of treatment is called induction therapy. More inpatient treatment is usually needed even after a patient is in remission. This is called postremissiontherapyand consists of consolidation therapy and in some cases maintenance therapy.

This part of treatment may include chemotherapy with or without stem cell transplantation. Chronic Myeloid Leukemia (CML). Patients with CML need treatment.

Platlets disorders

Thrombocytopenia

Thrombocytopenia is a conditioncharacterized by abnormally low levels of Platelets, also known as thrombocytes, in the blood.

A normal human platelet count rangesfrom 150,000 to 450,000 platelets permicroliter of blood. It is the mostcommon coagulation disorder among ICUpatients and is seen in 20% of medicalpatients and a third of surgical patients. Values outside this range do not necessarily indicate disease.

One commondefinition of thrombocytopenia requiringemergency treatment is a platelet countbelow 50,000 per microliter.

Thrombocytopenia can be contrasted with thrombocythemia, and thrombocytosis, conditions of an abnormally high level ofplatelets in the blood.

Sign and Symptoms

Thrombocytopenia usually has no symptoms and is picked up on a routine complete blood count. Some individuals with thrombocytopenia may experience external bleeding such as nosebleeds, or bleeding gums.

Some women may have heavier or longer periods or break through bleeding.

Bruising, particularly purpura in the forearms and petec hiae in the feet, legs, and mucous membranes, may becaused by spontaneous bleeding underthe skin

Ensuringthat the other blood cell types, such as redblood cells and white blood cells are notalso suppressed, is also important.

Painless, round, and pinpointA person with this disease may alsocomplain of malaise, fatigue, and generalweakness.

Acquired thrombocytopeniamay be associated with the use of certaindrugs. Inspection typically reveals evidence of bleeding, along with slow, continuously.

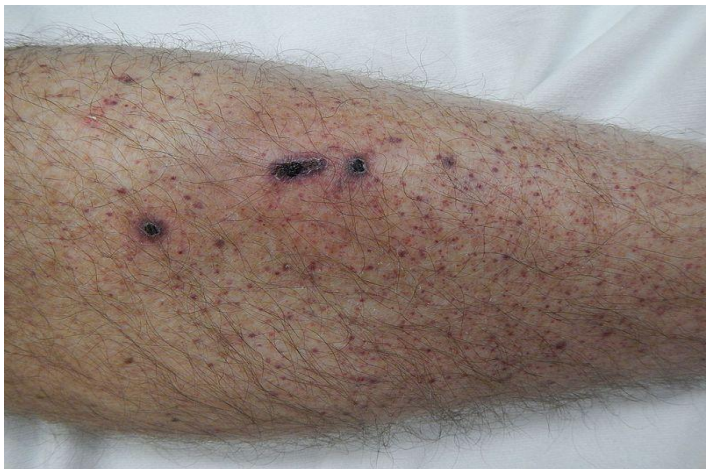


Fig: Petechia on the leg from cytopenia.

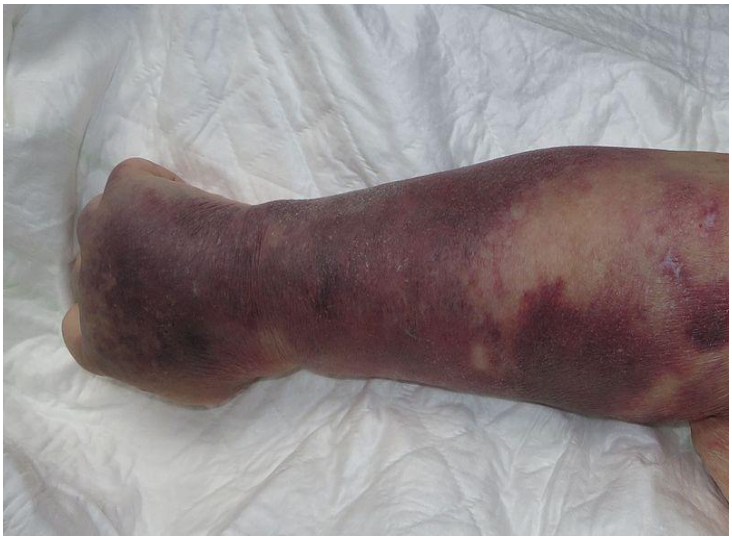


Fig: Hand with purpura cause by cytopenia.

Cause of cytopenia

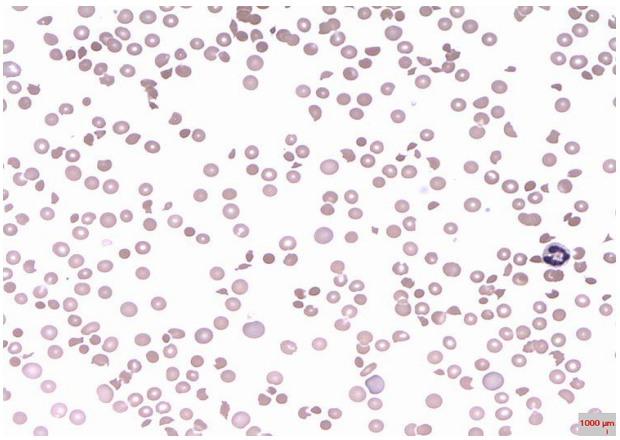
Thrombocytopenia can be inherited for acquired.

1) Decreased production

Abnormally low platelet production may becaused by

- Dehydration, Vitamin B12 or folic acid deficiency
- Leukemia, myelodysplastic syndrome, oraplastic anemia
- Decreased production of thrombopoietinby the liver in liver failure
- Sepsis, systemic viral or bacterialinfection
- Leptospirosis

2) Increased destruction



Abnormally high rates of platelet destruction may be due to immune or Non immune conditions, including

- Immune thrombocytopenic purpura
- Thrombotic thrombocytopenic purpura
- Post-transfusion purpura
- Neonatal alloimmune thrombocytopenia
- Hypersplenism
- Dengue fever
- Gaucher's disease
- Zika virus

3) Medication-induced

These medications can induce thrombocytopenia through direct Myelosuppression.

- Valproic acid
- Methotrexate
- Carboplatin
- Interferon
- Isotretinoin
- Panobinostat
- H2 blockers and proton-pump inhibitors

4) Other causes

Lab error, possibly due to the anticoagulant EDTA in CBC specime

Treatment

Treatment is guided by the severity and specific cause of the disease.

Focuses on eliminating the underlying problem, whether that means discontinuing drugs suspected to cause it or treating underlying sepsis. Diagnosis and treatment of serious thrombocytopenia is usually directed by a hematologist. Corticosteroids may be used to increase platelet production. Lithium carbonate or folate may also be used to stimulate platelet production in the bone marrow.

Platelet transfusions

Platelet transfusions may be suggested for people that have a low platelet count due to thrombocytopenia.

Blood plasma disorders

Hemophilia

It is an inherited bleeding disorder in which a person lacks or has low levels of certain proteins called “clotting factors” and the blood doesn’t clot properly as a result. This leads to excessive bleeding. There are 13 types of clotting factors, and these work with platelets to help the blood clot. Platelets are small blood cells that form in your bone marrow. According to the World Federation of Hemophilia (WFH), about one in 10,000 people are born with this disease.

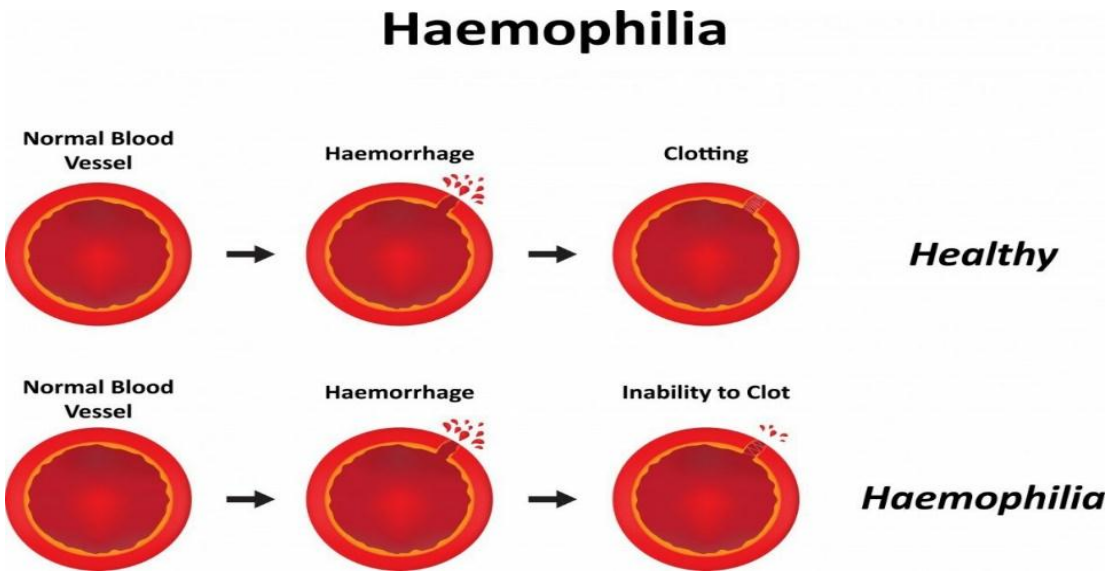


Fig: Haemophilia cells.

Symptoms of hemophilia

- Blood in the urine
- Blood in the stool
- Deep bruises
- Large, unexplained bruises
- Excessive bleeding
- Bleeding gums
- Frequent nosebleeds
- Pain in the joints
- Tight joints
- Irritability (in children)

Causes of hemophilia

A process in your body that's known as "the coagulation cascade" normally stops bleeding.

Blood platelets coagulate, or gather together at the wound site, to form a clot. Then the body's clotting factors work together to create a more permanent plug in the wound. A low level of these clotting factors or the absence of them causes bleeding to continue.

Hemophilia and Genetics

Hemophilia is an inherited genetic condition, meaning it is passed down through families. It's caused by a defect in the gene that determines how the body makes factors VIII, IX, or XI. These genes are located on the X chromosome, making hemophilia an X-linked recessive disease.

Treatment of Heamophilia

Your doctor can treat hemophilia A with a prescription hormone. This hormone is called desmopressin, which they can give as an injection into your vein. This medication works by stimulating the factors responsible for the process of blood clotting.

Your doctor can treat hemophilia B by infusing your blood with donor clotting factors. Sometimes, the factors may be given in the synthetic form.

These are called "recombinant clotting factors."Your doctor can treat hemophilia C using plasma infusion. The infusion works to stop profuse bleeding.

The deficient factor responsible for hemophilia C is only available as a medication in Europe. You can also go to physical therapy for rehabilitation if your joints are damaged by hemophilia.

Prevention of hemophilia

Hemophilia is a condition that's passed from a mother to her child. When you're pregnant, there's no way of knowing whether your baby has the condition. However, if your eggs are fertilized in a clinic using in vitro fertilization, they can be tested for the condition.

Then, only the eggs without hemophilia can be implanted. Preconception and prenatal counseling can also help you understand your risk of having a baby with hemophilia.

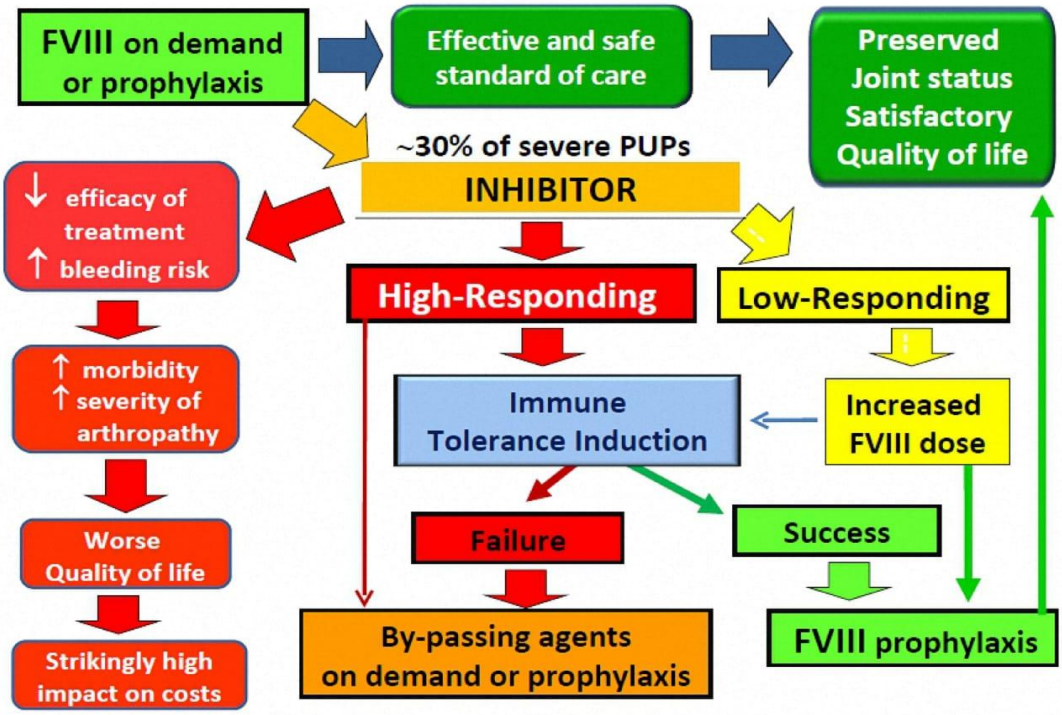


Fig: Prevention of haemophilia.

CONCLUSION

Effective case presentations are an important component of the nurse practitioner's skills. The ability to communicate information about patients is important for all care providers. The case presentation serves several purposes: it allows one to briefly convey a clear and comprehensive account of a patient's health problem to another provider.

It provides a mechanism for preceptors and peers to assess the level of expertise one has regarding a particular problem and to evaluate the assessment and management portion of that patient's care; and finally, a clearly articulated case presentation enables the nurse practitioner to get a more experienced clinician's opinion about a patient in an efficient, inexpensive manner.

Nurse practitioners who can present a clear and comprehensive account of a patient's health problems enjoy an advantageous position with regard to interacting with colleagues and obtaining input from other professionals, thus improving patient care and in this case. especially in those with hematologic disorders.

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