

Blood typing 101

Made up of distinct components with unique functions and divided into different groups, blood is vital to life. With 5 million Americans needing a blood transfusion every year, one of the most important things a nurse must know how to do is safely administer blood products. We help you understand blood typing and cross matching to ensure your patient gets the correct blood and prevent transfusion reactions.

By Melissa Moye, BSN, RN, CCRN
Staff RN • North Florida Regional Medical Center
Gainesville, Fla.

Having the right amount of blood in our bodies is essential to good health. For hundreds of years, physicians tried to save lives by giving blood transfusions, but they didn't understand blood groups or how to type and cross match donor blood with the recipient before a transfusion was given. Unfortunately, many patients died—that is until 1901, when Austrian biologist and physician Karl Landsteiner discovered the concept of blood groups.

In this article, I'll discuss blood groups, cross matching, and the components of blood, and explain the common procedures involved in administering blood transfusions.

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The “in” group

The four blood groups are A, B, AB, and O (see *ABO blood grouping system*). The differences in each group are determined by the presence of certain protein molecules known as **antigens** (a foreign substance in the blood located on red blood cells [RBCs]) and **antibodies** (a protein manufactured in response to the presence of an antigen in the body located in blood plasma).

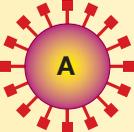
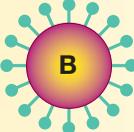
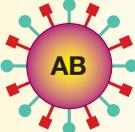
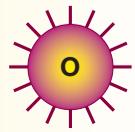
When the wrong type of blood is given to a patient, it clumps together—a potentially fatal process known as **agglutination**, an immunologic response that occurs when the cells of one type of blood interact with the antibodies of another type. For example, if a patient with A+ blood received B+ blood, the B antibodies in the A+ blood would attack the foreign RBCs and bind the antigens in the B+ blood. The agglutinated RBCs not only clump together and cause blockages in many vessels, but they also crack open and leak their hemoglobin into the body. Hemoglobin outside of the cell is toxic and can be fatal.

Rh factor is another way to group blood according to the presence or absence of the Rh antigen, which was discovered in 1940.

An Rh-negative patient should never be given Rh-positive blood. The first time may not illicit negative effects, but after the Rh antibodies are formed, subsequent transfusions could cause agglutination.

This is also a danger in pregnancy when the mother is Rh-negative and the father is Rh-positive. The first child is in no danger, but if some blood mixes with the mother’s blood during labor, the mother forms anti-Rh antibodies and any subsequent pregnancies could be at risk. Erythroblastosis fetalis, also known as hemolytic disease of the newborn, occurs when the mother’s blood containing anti-Rh antibodies attacks any Rh-incompatible fetus. Treatment consists of the mother receiving a vaccine after the first birth to destroy the fetal blood cells before she can form the antibodies and thus protect future fetuses from attack.

There are eight different blood groupings based on Rh factor, each either Rh-positive or Rh-negative (see *Rh typing*). A **universal donor** is someone with group O Rh-; they can donate blood to anyone. This group is used in emergencies when there isn’t time to type or cross match the blood. A **universal**

ABO blood grouping system				
	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	No antigens



receiver is someone with AB Rh+; they can receive blood from anyone.

Are you my type?

Cross matching is a procedure to check for antibodies to different antigens after the blood group and Rh factor are known (see *Making a match*). It's the final step in testing for compatibility. The blood from a donor is mixed in a test tube with the blood from the recipient. If any clumping occurs, then the blood isn't compatible and further testing will be needed.

Minimize transfusion confusion

Approximately 5 million people in the United States need a blood transfusion every year due to illness or injury. There have been many medical advances over the years, but a synthetic blood product hasn't been created yet. There are medicines that can help your body make more RBCs, such as erythropoietin, but so far there's no substitute for receiving blood from another person.

Fifteen million units of whole blood are collected every year in the United States. Ninety-eight percent of these are from volunteer donors. Sometimes a person will donate blood to be used by himself or herself at a later date, known as **autologous** blood. A person can donate up to 3 units of his or her own blood if surgery is anticipated. This isn't risk-free, but it's safer than **allogeneic** blood (blood that's donated by someone else). The benefits of an autologous blood transfusion include the reassurance of an exact match because it's the patient's own blood and no risk of an infectious agent being transmitted.

RBCs, plasma, cryoprecipitate, platelets, and white blood cells (WBCs) are gained from each unit of donated whole blood. Whole blood is rarely transfused except in cases of severe trauma or surgery with massive blood loss. Each type of blood product has its own set of guidelines for transfusing. However, the first step for all of them is to obtain a blood consent form.

Rh typing

A Rh+	B Rh+	AB Rh+	O Rh+
A Rh-	B Rh-	AB Rh-	O Rh-

Red blood cells

RBCs are transfused more than any other blood component. They contain hemoglobin, which carries oxygen to the cells throughout the body. Produced in the bone marrow, RBCs live about 120 days in the circulatory system and are constantly being broken down and then removed by the spleen. There are approximately 25 trillion RBCs in the average adult.

Transfusion of RBCs, or packed cells, is indicated when hemoglobin or hematocrit is low. Monitor closely for signs and symptoms of transfusion reaction, including anxiety, chest pain, fever, chills, nausea, trouble breathing, and shock. If your patient experiences any adverse reaction, stop the transfusion immediately and notify the healthcare provider.

Read your institution's policy manual because most have standing orders to follow. For example, obtain pretransfusion vital signs, including temperature, at 15 minutes, and then posttransfusion; ensure that the entire unit is transfused within a certain time frame, usually under 4 hours; and have each unit verified with another RN for the right patient, birth date, medical record number, and blood type.

Some things to remember when transfusing RBCs:

- Always use special blood tubing with a micron filter.
- Prime tubing using normal saline solution only.
- Never administer medications or other blood products via an infusion line.
- Transfusion must begin within a certain amount of time after the blood product leaves the blood bank; usually within 30 minutes.

Plasma and cryoprecipitate

A liquid part of the blood, *plasma* is a protein-salt solution that also has many other dissolved components such as hormones, minerals, fats, enzymes, coagulation factors, and carbohydrates. It constitutes about 55% of the total blood volume and is approximately 90% water. Plasma delivers nutrients to the body and carries away the waste products of metabolism. RBCs and WBCs are suspended in this solution, along with substances such as albumin, fibrinogen, and globulins.

Albumin is a valuable water-soluble protein that transports fatty acids to the muscles, as well as hormones, drugs, and other substances through the blood. *Fibrinogen* is another blood protein that's essential in the coagulation of blood. It interacts with thrombin to form a fibrin network that traps blood cells. The plug formed is the last step in the blood clotting process. *Globulins* include different enzymes and antibodies that the body produces to fight infections and disease.

Cryoprecipitate is a portion of the blood that contains many clotting factors. It's most commonly used to replace fibrinogen in patients with low levels of clotting proteins

such as in hemophilia or von Willebrand disease.

Some things to remember when transfusing plasma and cryoprecipitate:

- These should be administered as fast as possible, usually around 10 mL/minute, either via gravity or pump.
- They must never be refrozen.
- They're typed for ABO compatibility only.

Platelets

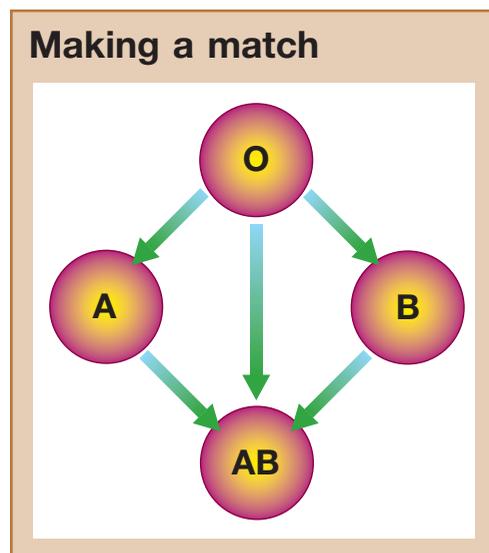
Platelets are small and irregularly shaped particles that help control bleeding by sticking to the lining of blood vessels. If there's an injury to a blood vessel, the blood leaks out into the surrounding tissue. Platelets gather and pile at the site of injury and release chemicals that form a web of fibrin threads. RBCs and WBCs also get caught in this web to form a large plug. The plug continues to grow until it's a firm and solid clot.

Platelets are given to patients to prevent bleeding or when the platelet count is very low (thrombocytopenia). They can be pooled from several donors or obtained by apheresis, in which a machine that separates the blood into different components and takes only the part that's needed by the recipient is connected to a donor; the remaining blood is then returned to the donor.

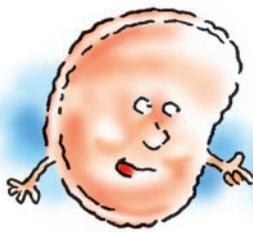
Platelets must be stored at room temperature and transfused immediately upon arrival to the clinical area.

Some things to remember when transfusing platelets:

- You don't need to use a filter because all platelets are *leucodepleted*—the removal of WBCs that cause most reactions during or after a transfusion. Furthermore, the use of any form of filter can decrease the platelet volume.
- Platelets can be transfused quickly; usually over 30 minutes.
- Don't use the same tubing for packed RBCs and platelet transfusions; they may be of different ABO groups and result in agglutination.



One out of seven hospitalized patients needs a blood transfusion.



White blood cells

WBCs are a major part of the immune system. They're produced in the bone marrow and travel through the blood to infected tissue areas where they ingest bacteria, viruses, parasites, and fungi. There are several types of WBCs, and each one specializes in a different task. WBCs are divided into either *granulocytes* (the presence of granules in the cytoplasm) or *agranulocytes* (lacking granules in the cytoplasm). Granulocytes include neutrophils, eosinophils, and basophils. Agranulocytes include monocytes and lymphocytes.

WBC transfusions are rare. Donated WBCs must be given immediately because the granulocytes last for only a few hours in the bloodstream. Febrile transfusion reaction can occur and infectious diseases can be transmitted via a WBC transfusion, which can be dangerous for people with weakened immune systems. In fact, WBCs are often removed from transfusable blood components.

At one time, WBCs were given to cancer patients who couldn't produce their own or whose WBCs had been destroyed by chemotherapy or other medicines. Although patients receiving chemotherapy often have low WBC levels, healthcare providers are now ordered drugs called colony-stimulating factors, or growth factors, to help the patient's body produce its own WBCs.

The conservative approach

There are many causes of anemia in critically ill patients, such as trauma, surgery, chemotherapy, myelosuppressive drugs, renal insufficiency, malnutrition, and endocrine disorders. However, some people may refuse to receive blood products, either for religious reasons or fear of the possible risks involved. Conserving blood and reducing blood loss are very important in the care plans of these patients.



A blood transfusion may seem to be the logical treatment of choice, but some research has suggested that the risks may outweigh the benefits. The risks of blood transfusions may include the following:

- allergic reactions
- pulmonary edema
- hepatitis
- bacterial contamination
- graft versus host disease
- coagulopathy
- anaphylaxis
- hemolytic transfusion reaction
- HLA alloimmunization
- thrombocytopenia.

Rather than giving a blood transfusion, it may be possible to prevent blood loss and conserve blood by adhering to the following basic practices:

- Reduce diagnostic blood loss during phlebotatic testing:
 - Decrease the volume of wasted blood when drawing from central or arterial lines (2 mL from an arterial line or two times the amount of dead space in the catheter).
 - Use child-size phlebotomy tubes and fill tubes only as full as necessary to obtain the result ordered.
 - Eliminate standing orders for blood tests and/or cancel the tests as soon as possible.
 - Coordinate collection times when numerous blood tests are ordered.
- Reduce hemorrhagic blood loss:
 - Monitor for indications of renal failure and/or occult bleeding.
 - Be alert for overt signs of bleeding from wounds or incisions and apply pressure dressings as ordered by the healthcare provider or hospital policy.
 - Monitor BP and coordinate actions with the healthcare provider to prevent hypertension that may lead to increased bleeding.
 - Ensure that patients are receiving prophylactic drug treatment to prevent gastrointestinal bleeding (discuss medication options with the healthcare provider).

—Review and limit drugs that may inhibit the coagulation cascade (such as heparin and aspirin).
 —Review diet orders to ensure the patient is receiving the proper nutritional support.
 —Suggest using hemostatic agents such as desmopressin or recombinant factor VIIa.

Desmopressin is a synthetic analog of the natural hormone vasopressin that exerts powerful vasoconstrictor action and stimulates endogenous hemostasis. It shortens bleeding time and prolonged activated partial thromboplastin time, and increases factor VIII and von Willebrand factor. It has no effect on aggregation or platelet count, but it does encourage the platelets to adhere to the vessel walls.

Recombinant factor VIIa is a coagulation factor concentrate that has been successfully used for bleeding related to trauma, surgery, and acquired congenital thrombocytopenias. In healthy people, it reverses the effect of warfarin, and it corrects prothrombin time in patients with hepatic failure. Studies suggest, however, that routine use isn't recommended because its effectiveness as a hemostatic agent remains uncertain.

Life's blood

Blood is invaluable to life. There's no substitute for its life-giving qualities to carry oxygen and nutrients, fight infection, carry away waste products, and form clots to prevent bleeding. One out of every seven people who enter the hospital, and one person every 3 seconds, needs a blood transfusion.

To safely administer blood products, you must understand the rationale for the transfusion, ensure that the correct blood product has been ordered, and know how to recognize a blood transfusion reaction, manage the reaction, and administer adequate treatment if a reaction has occurred. ■

Learn more it about it

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The author has disclosed that she has no financial relationships related to this article.

DOI-10.1097/01.NME.0000413346.98187.01



did you know?

RBCs can be stored for 42 days; platelets for 5 days; and fresh frozen plasma for 1 year.