

Apheresis

- A technology that separates donated blood components to treat certain illnesses
- For people with sickle cell disease, leukemia, myasthenia gravis, and other blood disorders
- Process takes two to four hours and is similar to a regular blood donation
- Involves laboratory medicine, clinical hematology laboratory, pediatric hematology and oncology

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Overview

Human blood is made up of four components: red blood cells, white blood cells, platelets, and plasma. Sometimes, to treat an illness, one of those components may need to be removed or replaced through a process called apheresis. Apheresis uses a centrifuge that separates blood into its components by density.

At Yale Medicine's Transfusion Medicine Service, a team of experts works with more than 1,000 patients a year to provide safe and comfortable treatment. Yale Medicine has the most up-to-date apheresis equipment, and our site often participates in clinical trials to explore new therapeutic apheresis applications.

How does apheresis work?

In traditional blood donation, a unit of whole blood is taken from a donor and sent to a laboratory, where it is separated into its four components - red blood cells, white blood cells, platelets and plasma. The components are stored and, depending on the medical need, given to patients after surgery, an accident, illness, or following chemotherapy.

Apheresis separates the blood into these components while the donor is still connected to the separation device. A rotating centrifuge or a rotating belt separates the donor's whole blood into its components based on density.

"Red cells are the densest, so they go to the bottom," says [Edward Snyder, MD](#), director of the Transfusion Service. "The next in order of density are white cells, platelets, and plasma."

Using sterile equipment, the apheresis operator directs the needed component into a collection bag; the others return to the donor through a needle inserted into a vein in the arm. (Some patients have the blood collected and returned through a central line, a catheter inserted into a vein in the upper shoulder.)

What is donor apheresis?

In donor apheresis, a healthy person donates blood using the apheresis machine, which is programmed to collect the desired blood component - either red blood cells, white blood cells, platelets, or plasma. The component can be stored and distributed to hospitals, to be given to a patient in need. The apheresis collections are drawn at blood donor centers or at mobile blood drives such as those run by the Connecticut chapter of the American Red Cross.

Donor apheresis takes longer than a whole blood donation, but is easy and painless, and has many benefits.

A machine apheresis double-red-cell donation, for example, separates red blood cells and returns the remaining “non-targeted” plasma or platelets to the volunteer donor. This way centers can collect twice as many red blood cells as they would in a whole-blood donation. A platelet apheresis donation can provide as many platelets as those obtained in four to six whole-blood donations.

Donated apheresis plasma may be frozen or sent to a processing facility, where it is treated and processed to create such pharmaceutical products as gamma globulin. Platelets may be donated as often as every seven days, though with double apheresis red cell donations, a donor has to wait up to 16 weeks before giving again.

What is therapeutic apheresis? ---

The Transfusion Medicine Service performs therapeutic apheresis on patients who have an illness associated with an abnormal cellular or plasma-based blood component. The abnormal parts of the blood are isolated and removed, then the normal components of the patient’s blood are returned to the veins.

“There may be buildup of an abnormal protein in the blood plasma causing a problem for some patients,” Dr. Synder says. “And we can separate and remove the abnormal plasma and replace it with a solution of 5 percent human albumin prepared from healthy donors to make up the volume that has been removed.”

If there are too many white blood cells, a leukapheresis can be performed, or if there are too many platelets, a plateletapheresis can be requested.

“We can also remove damaged red blood cells, and replace them with red cells from a normal donor,” says Dr. Snyder.

What are some of the conditions that may be treated with apheresis? ---

Sickle cell disease. In this genetic condition, red blood cells are shaped abnormally (like sickles) and can’t carry oxygen through the body effectively. If they develop a sickle cell crisis, their sickled red blood cells can be removed using erythrocytapheresis and replaced with healthy cells from a blood donor.

Leukemia. Patients with leukemia may have too many white blood cells, which can cause the blood to thicken and interfere with organ function. In the leukapheresis process, abnormal white blood cells are removed, and the rest of the blood is returned to the patient.

Myasthenia gravis. In this condition, a buildup of abnormal antibodies (proteins) in the plasma interferes with the communication between nerves and muscles. Using a type of apheresis called plasmapheresis, plasma is separated and removed from the patient's blood and replaced with a protein solution of 5 percent human albumin.

Thrombotic thrombocytopenic purpura (TTP). This rare blood disorder causes platelet clumps to form throughout the body due to a lack of a needed blood enzyme. The most effective treatment is plasmapheresis, followed by replacement with normal donor plasma, which contains the needed enzyme.

How is apheresis used for stem cell transplants? ---

Stem cells, immature cells that develop in the bone marrow, can grow into red blood cells, white blood cells, or platelets. In patients with some types of cancers of the blood, such as leukemia, multiple myeloma and lymphoma, those stem cells can be harvested from the patient by apheresis and then returned after the patient has gone through chemotherapy or other treatments.

The patient is first given a growth factor medication to increase the number of stem cells, which are then separated through leukapheresis while the rest of the blood is returned to the patient. The collected stem cells are frozen and stored until the patient has completed chemotherapy or radiation treatments.

"When we give back the stem cells," says Dr. Snyder. "These stem cells can grow and repopulate the patient's bone marrow after their stem cell transplant. Fortunately, these cells usually come back healthy."

"We've been doing this procedure successfully in close collaboration with medical oncology, for years and years. It is now a standard approach for treating many forms of blood cancer."

What can a patient expect when undergoing apheresis? ---

The patient sits in a comfortable chair and can watch television while undergoing the process, which can take from two to four hours, depending on the patient's illness and what component needs to be collected. As with regular blood donations, apheresis is generally painless, though there may be some side effects, such as discomfort in the arm where the needle is inserted, lightheadedness, sweating, or a drop in blood pressure.

Because apheresis takes longer than regular blood donation and involves needles in two arms rather than one, there may be an increased chance of experiencing those effects, says Dr. Snyder. However, he says, the vast majority of apheresis patients don't experience any side effects.

If a patient is receiving donor components such as red blood cells as part of the treatment, there is a small risk of allergic reaction or fever, but Dr. Snyder points out that patients are monitored very closely and any adverse reactions are identified and addressed quickly.

Treatment may be repeated once a week or once a month, or it can be done several times over a week, if needed. Apheresis therapy is almost always done in conjunction with other medications and treatments, such as steroids or chemotherapy.

What makes Yale Medicine's approach to apheresis unique? ---

Yale Medicine follows the highest medical safety standards, and because it is a large research hospital, we have a team of Blood Bank physicians on call at all times, Dr. Snyder says. "We have the most up-to-date apheresis equipment, and our site often participates in clinical trials to explore new therapeutic apheresis applications to treat patients with varied diseases."

Though most apheresis treatments are scheduled during the day, Yale Medicine's center is open 24 hours a day, 7 days a week, in case of emergency.

"Our staff is dedicated to ensuring patient safety, patient comfort and appropriate medical care," says Dr. Snyder. "We are there for our patients around the clock."

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