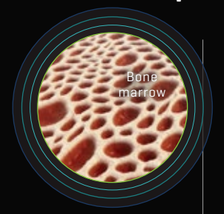
BONE MARROW TRANSPLANT INS AND OUTS

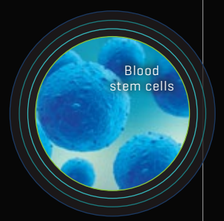
Bone marrow and blood stem cell transplantation is one of the greatest success stories in cancer care. Pioneered at Fred Hutch by Dr. E. Donnall Thomas, who won the 1990 Nobel Prize in physiology or medicine for his work, and steadily refined by Hutch teams over four decades, the treatment has transformed survival rates for some leukemias and other blood disorders from zero to upwards of 90 percent. For patients with certain diseases, it remains the only therapy available with the potential to cure.

Steps in the transplant process

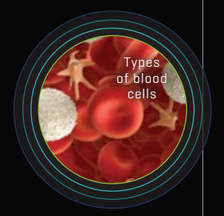


THE ROLE OF BONE MARROW

Marrow contains blood stem cells



that generate the components of the blood and immune system:



infection-fighting white blood cells, oxygen-carrying red blood cells and platelets, which help blood clot.

❶ Preparation

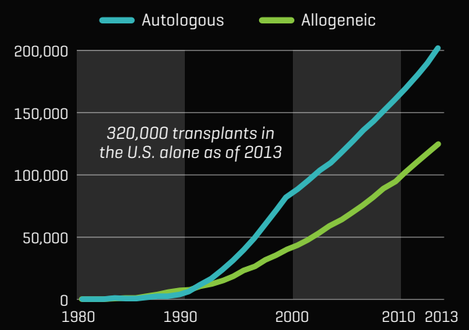
Doctors conduct a thorough exam to confirm the best type of transplant.

Autologous transplant
Patient serves as their own stem cell donor. Most commonly used for patients with lymphomas.

Allogeneic transplant
Someone other than the patient donates stem cells. Most commonly used for patients with leukemias, blood disorders like aplastic anemia and immunodeficiencies.

A SIGN OF SUCCESS

The number of transplants performed has grown dramatically as Hutch research and training boosted the procedure's success and availability.



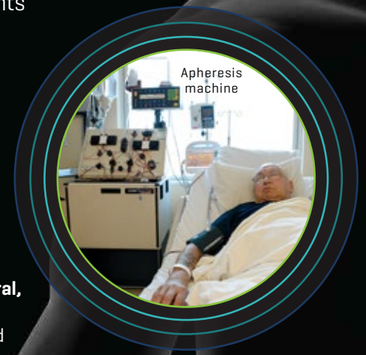
Learn more or consider becoming a bone marrow donor. Go to: ***bethematch.org*** *or* ***giftoflife.org.***

Design: Jim Woolace; Reporting: Andrea Detter
Photos: Bo Jungmayer, iStock, Dr. Cecilia Yeung
Sources: Fred Hutch, SCCA, Be The Match, Center for International Blood and Marrow Transplant Research, Appelbaum FR. N Engl J Med 2007;357:1472-5

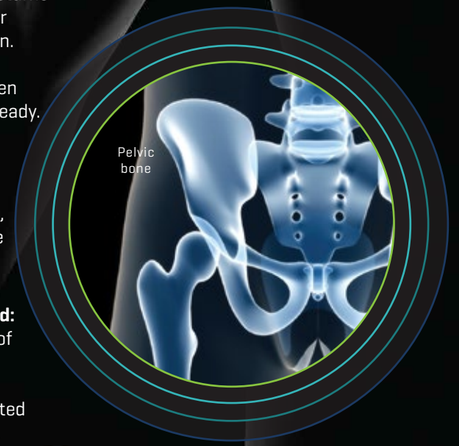
❷ Stem Cell Collection

Blood stem cells are collected from one of three sources:

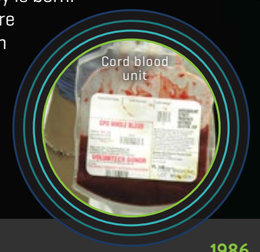
Circulating, or peripheral, blood: Donors get an injection to make — and release into the blood — more stem cells. A few days later, an apheresis machine sifts 12 ounces of stem cells from the donor's blood and returns the rest to the donor through another vein. Cells can be used immediately or frozen until the patient is ready.

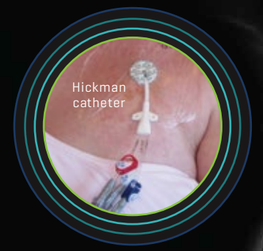


Bone marrow: 1-2 quarts of marrow, which the body replaces in a month, are drawn out of the pelvic bones with a needle.



Umbilical cord blood: About 5 teaspoons of stem cells are collected from an umbilical cord donated after a baby is born. The cells are then frozen for future use.





❸ Pre-Transplant Conditioning

Next, the patient's body is prepared to receive the new cells.

A Hickman catheter — developed at Fred Hutch by Dr. Robert Hickman — is surgically implanted to administer drugs and take blood samples without repeated needle sticks.

Over the course of a week, patients receive high doses of chemotherapy, total body irradiation or both to eliminate as much of the cancer (or other disease-causing cells) as possible and reduce the chances an allogeneic transplant will be rejected. This preparative regimen leaves patients highly vulnerable to infections.

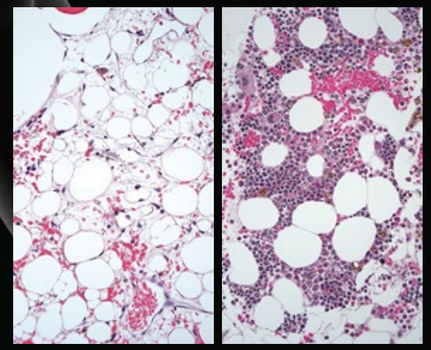
Some patients undergo regimens of reduced intensity. Pioneered by Fred Hutch's Dr. Rainer Storb, these regimens use lower doses of chemotherapy and radiation that aren't as toxic. They have extended transplantation to patients who are older or have additional medical complications.

❹ Stem Cell Infusion

A few days after conditioning, patients receive stem cells intravenously, which then flow through the bloodstream and settle in the marrow. The infusion can last several minutes to several hours depending on the volume of cells delivered.

❺ Engraftment

Engraftment is when the donated cells (the graft) take root in the bone marrow and begin to make healthy new red blood cells, white blood cells and platelets. It can take 10 days to several weeks and eventually changes the patient's blood type to that of his or her donor.



Marrow with almost no functioning stem cells

After transplant, healthy cells repopulate the marrow

❻ Recovery

For the next 100 days, patients get daily or weekly check-ups to track their progress and monitor for infections and other complications. It can take a year or more for blood counts to normalize and the new immune system to work well.

TRANSPLANT'S YIN AND YANG

Roughly half of allogeneic transplant patients experience graft-vs.-host disease, a potentially life-threatening complication that arises when donated cells attack the patient's healthy tissues.

A related phenomenon, called the graft-vs.-leukemia effect, occurs when donated immune cells recognize the patient's cancer as foreign and attack it. The discovery of this effect is a cornerstone of modern cancer immunotherapy since it revealed that the human immune system has the ability to eliminate tumors.

FINDING A MATCH

Transplant success hinges on finding the right donor. Allogeneic transplant patients and donors are matched by immune molecules called human leukocyte antigens. HLA matching minimizes graft rejection and GVHD. If a patient has no matching relative, specialists search national and international registries to find a volunteer donor. If no match can be identified, patients may be able to use cord blood stem cells, which don't need to be as closely matched.

1975
Thomas publishes first indication that BMT could cure some patients

1976
Hutch establishes first pediatric BMT program

1978
Hutch teams recognize that the transplanted immune system can eliminate the patient's cancer, laying the foundation for modern cancer immunotherapy

1979
Successful transplant from a matched, unrelated donor at Fred Hutch opens door to registries of volunteer marrow donors

1986
Hutch researchers first treat GVHD with methotrexate and cyclosporine, now the gold standard

1990
Hutch team is first to use non-invasive method to detect cytomegalovirus, and ganciclovir to prevent CMV-related pneumonia, boosting survival and launching new era in infectious disease research

1991
Hutch is first to use peripheral blood stem cells, simplifying donation and speeding engraftment

1997
Hutch researchers introduce regimens of reduced intensity for older patients and those with medical complications

2005
Hutch scientists develop new method for multiplying stem cells to make cord blood transplants an option for more patients with no matched adult donor

2012
World's 1 millionth transplant performed