Patient Education

UNDERSTANDING TRANSPLANT IN LYMPHOMA

Hematopoietic cell transplantation (HCT), also called stem cell or bone marrow transplantation, is a treatment option for patients with blood cancers such as leukemia, multiple myeloma, or lymphoma. Together with radiation therapy or chemotherapy, HCT is designed to increase the chance of eliminating the blood cancer and restore normal blood cell production. Read on to learn more about how HCT is used to treat lymphoma.

This "Patient Education" tear sheet was produced in collaboration with the Lymphoma Research Foundation (*www.lymphoma.org*).

What Is Hematopoietic Cell Transplantion?

Hematopoietic cell transplantation is a procedure that replaces unhealthy blood-forming cells with healthy cells. A hematopoietic or stem cell is an immature cell in the bone marrow that can develop into mature blood cells. These mature cells maintain a person's blood cells, replacing older or damaged cells with newer ones.

The ability to transplant stem cells allows physicians to use higher doses of chemotherapy to treat the cancer than the body would normally tolerate, because high-dose chemotherapy can cause significant damage to stem cells. If the chemotherapy is followed by an infusion of stem cells, these new stem cells can replace the cells in the bone marrow that were destroyed during the chemotherapy treatment.

Who Can Receive a Hematopoietic Cell Transplant?

High-dose chemotherapy and HCT may place a great strain on a patient's body, so this is not an option for everyone. This procedure is typically used for patients with relapsed (disease returns after treatment), aggressive lymphoma that is still sensitive to the effects of chemotherapy. The procedure does not work for patients with tumors that are unresponsive to drugs.

When deciding if transplantation is a good option, doctors will consider many factors, including the patient's health status, age, medical history, cancer stage, and response to previous therapy.

Types of Hematopoietic Cell Transplants

Autologous Hematopoietic Cell Transplantation

In autologous HCT (AHCT), hematopoietic cells are donated by the patient and collected and frozen before the patient undergoes cancer treatment. After cancer treatment is administered and the cancer cells are believed to be gone, the collected stem cells are reinfused back into the patient.

Because a patient is receiving his or her own hematopoietic cells, an AHCT ensures a perfect match between the patient and the transplanted cells, which improves outcomes. Additionally, this procedure has a lower risk of transmitting blood-borne infectious diseases.

Allogeneic Hematopoietic Cell Transplantation

In allogeneic HCT (AlloHCT), the hematopoietic cell donor is not the patient, but rather another person who is genetically similar – often a sibling – though it is possible for the donor to be unrelated to the patient. After the patient has undergone chemotherapy and/or radiation therapy, the donor's hematopoietic cells are infused into the patient.

As these donated cells take hold (or engraft) in the recipient, they begin to function as part of the immune system and may attack the cancer cells. This is referred to as *graft-versus-tumor effect*, which only occurs in AlloHCT.

In some cases, the donor cells also attack the patient's healthy cells. This is called *graft-versus-host disease* (GVHD). The more closely related the donor's cells are to the patient's cells, the lower the risk of GVHD.

Reduced-Intensity Transplantation

Reduced-intensity transplantation (also called *non-myeloablative or mini-allogeneic transplantation*) is a type of allogeneic transplantation. Unlike a standard allogeneic transplant, this treatment uses lower doses of chemotherapy and/or radiation to prepare the patient for the transplant. The reduced-intensity treatment kills some of the cancer cells and bone marrow, and it suppresses the patient's immune system just enough to allow the donor's stem cells to settle into the bone marrow.

These types of transplants are used in patients with adverse health conditions or older patients to avoid the potential adverse effects of destroying bone marrow during standard high-dose chemotherapy (with or without radiation).

Sources of Hematopoietic Cells for Transplantation

Hematopoietic cells for transplantation can be obtained from three sources: bone marrow, peripheral blood, and umbilical cord blood.

Bone Marrow

Bone marrow, the tissue inside bones where blood cells are generated, is a good source of hematopoietic cells, and cells from the pelvis or hip bone are most often used

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Patient Education

Lymphoma Research Foundation Patient Resources

The Lymphoma Research Foundation (LRF) offers patients with lymphoma and chronic lymphocytic leukemia a wide range of resources that provides a comprehensive overview, as well as addresses treatment options, the latest research advances, and ways to cope with all aspects of lymphoma.

LRF also provides many educational activities, from in-person meetings to teleconferences and webcasts, as well as an *Understanding the Hematopoietic Cell Transplantation Process* booklet, e-Updates that provide the latest disease-specific news and treatment options, and an award-winning mobile app (*Focus on Lymphoma*) that provides tools to help manage the disease.

For more information about any of these resources, visit LRF's website at *www.lymphoma.org* or contact the LRF Helpline at 800-500-9976 or *helpline@lymphoma.org*.

for a bone marrow transplant. Bone marrow hematopoietic cells can be used for both AHCT and AlloHCT.

To remove the stem cells, the person whose hematopoietic cells are being collected (the donor) is given general anesthesia. A large needle is then inserted into the bone and some of the bone marrow is removed and frozen. The marrow that is removed (harvested) is passed through a series of filters to remove bone or tissue fragments and then placed in a plastic bag from which it can be infused into the recipient's vein, usually within a few hours. Alternately, the marrow can be frozen and stored for years.

When it is time for the patient to receive the hematopoietic cells, the marrow is given through a vein, just like a blood transfusion. A hospital stay of about six to eight hours after the procedure can be expected in order to recover from the anesthesia and the pain at the needle insertion sites.

Peripheral Blood

Hematopoietic cells collected from blood are commonly used in HCT. Normally, only a few stem cells are found in the blood. A drug called granulocyte colony-stimulating factor, or G-CSF (filgrastim, lenograstim, and pegfilgrastim), is given to stimulate hematopoietic cell growth and improve the ability to collect an appropriate number of hematopoietic cells. The hematopoietic cells are collected through a process called *apheresis*: the blood is removed through a catheter, the cells are collected, and the rest of the blood is returned to the donor. The entire procedure takes three to four hours but needs to be repeated several times. The hematopoietic cells are treated to remove contaminants and are then frozen to keep them alive until the patient is ready to receive them.

Umbilical Cord Blood

After the birth of a newborn, some of the baby's blood is left behind in the placenta and umbilical cord. This is known as cord blood. This blood can be collected and frozen until needed for later use in an HCT. HCTs with umbilical cord blood are not as common as those from other sources. This is because there are a smaller number of hematopoietic cells present, and cord blood transplants can take longer to engraft (enter the marrow to replace the damaged hematopoietic cells) and start working. Umbilical cord blood HCTs can be considered for children or small-sized adults and in situations where a well-matched donor could not be found among family members or those who have signed up to donate.

The Transplantation Process

Once donor hematopoietic cells have been obtained, patients undergoing hematopoietic cell transplantation will experience a similar procedure whether they are undergoing an autologous or allogeneic transplant.

Preparatory Therapy

Transplants are preceded by chemotherapy treatment to inactivate the immune system and reduce the tumor burden, killing malignant cells. These preparative treatments are extremely toxic and may contain radiation. Total body irradiation with etoposide and/or cyclophosphamide chemotherapy may be used. To decrease the toxicity, the therapy may be "fractionated," meaning that the radiation dose is given over several days. In patients unable to undergo total body irradiation, BEAM (carmustine, etoposide, cytarabine, and melphalan) and CBV (cyclophosphamide, carmustine, and etoposide) are two commonly used regimens

Monoclonal antibodies, such as rituximab, may also be used.

Infusion of the Transplanted Hematopoietic Cells

A few days after treatment, the patient is given the stored hematopoietic cells. Donor hematopoietic cells are delivered through the central line – a long, thin tube (intravenous catheter) implanted in the chest near the neck. Infusing the hematopoietic cells usually takes several hours. Patients may experience fever, chills, hives, shortness of breath, or a drop in blood pressure during the procedure. To stimulate the growth of infection-fighting white blood cells, G-CSF may be given. Additionally, blood cell replacement, nutritional support, and drugs to treat GVHD may be used. Hospital stays can be three to five weeks.

The patient is kept in a protected environment to minimize infection. Risk of developing a severe, potentially life-threatening infection is highest two to three days following transplant until the hematopoietic cells have been able to re-populate the immune system, usually in about two to four weeks.

It is very important for patients to take precautions to avoid infections, which include ensuring that vaccinations are up to date prior to transplant; washing hands diligently; avoiding crowds; cooking all food; avoiding fresh flowers, gardening, and swimming; and not sleeping with pets.

Engraftment

During the first month following transplant, the transplanted cells will start to grow and produce healthy hematopoietic cells that appear in the blood. This process is referred to as *engraftment*. Frequent blood tests may be done to monitor this process. Complete recovery of immune function may take up to several months for autologous transplant recipients and one to two years for patients receiving allogeneic transplants.

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