What Is Hematopoietic Cell Transplantation?

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-myoablative 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...
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.