

Bone Marrow Transplant / Hematopoietic Stem Cell Transplant



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What is the bone marrow?

The bone marrow is the factory that produces different cells that form blood. It is the soft inner part of some bones, such as the skull, shoulder blades, ribs, pelvis, and bones in the spine. Immature cells are produced in the bone marrow. These are called the blood stem cells. With time and under the effect of maturation factors, these cells become mature blood cells. Broadly there are of two types –myeloid stem cell or a lymphoid stem cell.

A myeloid stem cell goes on to form one of three types of mature blood cells:

- Red blood cells that carry oxygen and other substances around the body.
- Platelets that help stop bleeding.
- White blood cells (granulocyte) that fight infection and disease.

A lymphoid stem cell becomes a lymphoblast cell (immature cell) and then one of three types of lymphocytes (white blood cells):

- B lymphocytes that make antibodies to help fight infection.
- T lymphocytes that help B lymphocytes make the antibodies that help fight infection.
- Natural killer cells that attack cancer cells and viruses.

Most blood stem cells are found in the bone marrow, but some are found in the bloodstream. They are called peripheral blood stem cells (PBSCs). Blood stem cells are also found in the umbilical cord blood. Cells from any of these sources can be used in transplants.

What is hematopoietic stem cell transplantation?

A hematopoietic stem cell transplant (HSCT) is a medical procedure performed to replace bone marrow that has been damaged or destroyed by disease, infection, or chemotherapy. In HSCT, blood stem cells are transplanted which travel to the bone marrow, and new blood cells are produced. This promotes new marrow growth.

There are three types of transplants:

- Autologous transplants - patients receive their own stem cells.
- Syngeneic transplants - patients receive stem cells from their identical twin.
- Allogeneic transplants - patients receive stem cells from their brother, sister, or parent. A person who is not related to the patient (an unrelated donor) also may be used.

What are the indications for HSCT?

HSCT is performed when the bone marrow does not function properly. This can be because of chronic infections, disease or cancer treatments. Some of the common reasons are:

- Aplastic anemia
- Cancers of the bone marrow
 - Leukemia
 - Lymphoma
 - Multiple myeloma
- Chemotherapy or radiation therapy damage to bone marrow
- Congenital neutropenia
- Sickle cell anemia
- Thalassemia

BLOOD DISORDERS

Clinic for Children

CANCER

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LIVER

Clinic

DIGESTIVE

Health Centre

CAPSULE

Endoscopy Centre

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How are a donor and recipient matched?

A close match is done between donor and recipient stem cells to minimize potential side effects. The surface of cells have human leukocyte-associated (HLA) antigens, which are proteins. These antigens are recognized by a special blood test. The success of allogeneic transplantation generally depends partly on how well the HLA antigens of the donor's stem cells match those of the recipient's stem cells. HLA matching is more likely in close relatives, especially siblings, than unrelated persons. Close relatives, especially brothers and sisters, are more likely than unrelated people to be HLA-matched. Identical twins have the same set of HLA antigens, which makes the body accept the transplant. However, identical twins are not common and thus syngeneic transplantation is rare.

How are the stem cells collected?

Stem cells are collected in two ways:

1. PBSCs are collected by apheresis, where blood taken from a vein is passed through a machine which removes the stem cells and returns the blood components back to the donor through a vein on opposite arm. This is a process in which the donor is connected to a special cell separation machine via a needle inserted in arm veins. Blood is taken from one vein and is circulated through the machine which removes the stem cells and returns the remaining blood and plasma back to the donor through

another needle inserted into the opposite arm. To ensure a successful transplant, enough stem cells are collected by many sessions of the collection procedure. The bone marrow of the donor may be stimulated to produce more new stem cells by a drug given seven days before apheresis.

2. Stem cells are collected by placing a needle in the bone marrow. This method is called bone marrow harvesting. The most common sites used are the sternum and hip bones. Anesthesia is given to the donor to avoid pain.

Umbilical cord blood may also be used to retrieve stem cells. Umbilical cord blood can be processed and frozen, and then stored for future use.

Are any risks associated with donating stem cells?

Donating bone marrow generally is safe for the donor. The most serious risk involves use of anesthesia during the procedure. There may be some stiffness or soreness for a few days at the site from where marrow was collected. The donor may feel tired, which goes away usually in 2-3 days but may take up to 3-4 weeks.

Donating PBSCs may cause minimal discomfort during apheresis:

- Lightheadedness
- Chills
- Numbness around the lips
- Cramping in the hands

The injections given to stimulate the release of stem cells in the bloodstream may cause:

- Bone and muscle aches

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- Headaches
- Fatigue
- Nausea
- Vomiting
- Difficulty sleeping

These side effects generally stop within 2 to 3 days of the last dose of the medication.

How are the stem cells given to the patient?

First high-dose chemotherapy and/or radiation therapy is given to the patient to kill any remaining cancer cells. Then the stem cells are given through an intravenous (IV) line just like in blood transfusion.

In autologous transplant, the harvested stem cells may be treated to remove the cancer cells before transplantation.

During the treatment, the patient will receive immune suppressants to prevent rejection. This will affect ability to fight infections.

What happens after the transplant?

The stem cells reach the bone marrow via the bloodstream. New red blood cells, white blood cells and platelets are produced in the bone marrow in a process called engraftment, which generally occurs within 2-4 weeks of transplantation. However, the immune function recovers totally after many months in an autologous transplant and 1 to 2 years in an allogeneic or syngeneic transplant.

What complications and side effects may occur following HSCT?

Patients who undergo HSCT may experience short-term side effects such as:

- Nausea
- Vomiting
- Fatigue
- Loss of appetite
- Mouth sores
- Hair loss
- Skin reactions
- Headache
- Pain
- Drop in blood pressure
- Fever
- Chills

Potential long-term complications include:

- Graft-versus-host disease (GVHD), which is a condition in which donor cells attack your body
- Graft failure, which occurs when transplanted cells don't begin producing new cells as planned
- Bleeding in the lungs, brain, and other parts of the body due to low platelets
- Cataracts, which is characterized by clouding in the lens of the eye
- Damage to vital organs
- Early menopause
- Infertility
- Anemia
- Infections
- Nausea, diarrhea, or vomiting
- Mucositis, which is a condition that causes inflammation and soreness in the mouth, throat, and stomach