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Perspective

The Development of Allogeneic Stem Cell Transplants in Blood Diseases

Hiroshi Yemataw*

Department of Medical Genomic Research, King Abdullah International Medical Research Center, Riyadh, Saudi Arabia

DESCRIPTION

Stem cells are the body's raw materials that can divide to form more cells or differentiate into specialized cells. One type of stem cells is blood-forming stem cells, which can grow into different types of blood cells, such as white blood cells, red blood cells, and platelets. These blood cells are essential for carrying oxygen, fighting infections, and preventing bleeding. Some diseases affect the production or function of blood cells, such as leukemia, lymphoma, multiple myeloma, myelodysplastic disorders, and aplastic anemia. These diseases can cause symptoms such as fatigue, infections, bleeding, and organ damage. Sometimes, these diseases can be treated with medication, but in some cases, a stem cell transplant may be a better option.

A stem cell transplant is a procedure that involves replacing the diseased bone marrow (the spongy tissue inside some bones that produces stem cells) with healthy stem cells from another source. There are two main types of stem cell transplants: autologous and allogeneic. An autologous transplant uses the patient's own stem cells, which are collected before treatment and returned after treatment. This type of transplant avoids the risk of rejection or Graft-Versus-Host Disease (GvHD), which are complications that can occur when the donor and recipient are not genetically identical. An allogeneic transplant uses stem cells from another person, ideally a close family member with the same or similar tissue type. This type of transplant has the advantage of providing new immune cells that can help fight any remaining cancer cells in the patient's body. This is called the graft-versus-tumor effect. However, this type of transplant also carries the risk of rejection or GvHD, which can be life-threatening.

Rejection occurs when the patient's immune system recognizes the donor cells as foreign and tries to destroy them. This can prevent the donor cells from engrafting in the bone marrow and producing new blood cells. GvHD occurs when the donor's immune cells attack the patient's healthy tissues and organs, causing inflammation and damage. GvHD can affect various parts of the body, such as the skin, eyes, mouth, liver, lungs, and gastrointestinal tract. To reduce the risk of rejection or GvHD, doctors try to find a donor who has a matching Human Leukocyte Antigen (HLA) type to the patient. HLA is a set of proteins on the surface of cells that helps the immune system distinguish between self and non-self. The more closely matched the HLA type between the donor and recipient, the less likely it is that complications will occur.

There are different sources of stem cells for allogeneic transplantation. The most common source is Peripheral Blood Stem Cells (PBSCs), which are collected from the donor's blood after they receive injections of a drug that stimulates the release of stem cells from the bone marrow into the bloodstream. Another source is Bone Marrow Stem Cells (BMCs), which are collected from the donor's hipbone using a needle and syringe. A third source is Umbilical Cord Blood Stem Cells (UCBs), which are collected from the placenta and umbilical cord after a baby, is born. Each source of stem cells has its advantages and disadvantages. PBSCs are easy to collect and have a high number of stem cells, but they may also have a higher risk of causing chronic GvHD. BMCs have a lower risk of chronic GvHD, but they are more invasive to collect and have a lower number of stem cells. UCBs have a lower risk of rejection or GvHD because they are less mature and more adaptable, but they also have a lower number of stem cells and may take longer to engraft.

Before undergoing an allogeneic transplant, the patient receives a conditioning treatment that consists of either chemotherapy or radiation therapy to destroy their own diseased bone marrow cells and prepares their body for the donor cells. The conditioning treatment can be either myeloablative or reduced-intensity. A myeloablative conditioning treatment uses high doses of chemotherapy with or without radiation therapy to completely wipe out the patient's bone marrow. This type of treatment has a higher chance of curing the disease, but it also has more side effects and requires a longer recovery time.

A reduced-intensity conditioning treatment uses lower doses of chemotherapy with or without radiation therapy to suppress but not completely destroy the patient's bone marrow. This type of treatment has fewer side effects and requires a shorter recovery

Correspondence to: Hiroshi Yemataw, Department of Medical Genomic Research, King Abdullah International Medical Research Center, Riyadh, Saudi Arabia, E-mail: yemata.roshi@gmail.com

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time, but it also relies more on the graft-versus-tumor effect to eliminate any residual disease. After the conditioning treatment, the patient receives an infusion of stem cells from the donor through a vein. The stem cells travel to the bone marrow and begin to grow and produce new blood cells. This process is called engraftment and usually takes two to four weeks. During this time, the patient is at a high risk of infection, bleeding, and other complications and needs to be closely monitored and supported with blood transfusions, antibiotics, and other medications.

After engraftment, the patient continues to receive follow-up care to check for signs of rejection, GvHD, relapse, or other problems. The patient may also receive immunosuppressive drugs to prevent or treat GvHD. The patient may need to stay in the hospital or nearby for several weeks or months until their immune system recovers and they can resume their normal activities. An allogeneic stem cell transplant is a complex and risky procedure that can have both short-term and long-term effects on the patient's health and quality of life. However, it can also be a curative treatment for some blood diseases that are otherwise difficult to treat. Therefore, it is important for patients and their doctors to weigh the benefits and risks of this procedure and make an informed decision based on their individual situation.