



Bone marrow transplantation

Bone marrow is a spongy tissue found in the breast bone (sternum), ribs, hip bones (pelvis), skull, and spine. Bone marrow produces white blood cells (which fight infection), red blood cells (which carry oxygen and nutrients throughout the body), and platelets (which aid blood clotting and healing). Any disease that stops production of these cells will eventually lead to death. Patients with bone marrow failure may have these symptoms: recurrent infections, easy bruising, lack of energy, and bleeding problems.

Who needs a bone marrow transplant?

Bone marrow transplantation can treat several diseases of the immune and blood systems:

- aplastic anemia
- cancer such as acute nonlymphocytic leukemia, chronic myelogenous leukemia, acute lymphoblastic leukemia, and lymphoma
- multiple myeloma, neuroblastoma, and selected solid tumours
- severe combined immune deficiency (a genetic disorder of the bone marrow)
- pediatric genetic disorders, such as inborn errors of metabolism and thalassemia major

Who can be a donor?

Bone marrow can only be obtained from living donors. There are three types of donor bone marrow: autologous, syngeneic, and allogeneic. Autologous transplantation uses the patient's own marrow, which had been previously removed and stored. Syngeneic transplantation uses genetically-identical bone marrow from an identical twin donor. Allogeneic transplantation uses bone marrow from a person who is not genetically identical to the recipient but matches sufficiently for the marrow graft to "take". In this case, blood from siblings can be "tissue typed" to see if there is a match. The closer the match, the less likely rejection will occur. Another alternative is unrelated bone marrow donation. [Canadian Blood Services](#) has a national registry of unrelated bone marrow donors for patients who do not have a relative with matching bone marrow. According to the [International Bone Marrow Transplant Registry/ Autologous Blood & Marrow Transplant Registry](#), about 30 per cent of allogeneic bone marrow transplants are from unrelated donors.

The procedure:

There are two methods used to collect the stem cells required for a bone marrow transplant □ bone marrow harvest or peripheral stem cell harvest.

(i) Bone marrow harvest

A few days before the transplant, the patient is treated with chemotherapy and, in some cases, total body irradiation. This treatment kills off all cancer cells, suppresses the immune system to prevent rejection of the new bone marrow, and creates space in the bone marrow for the new marrow. Syringes and needles are used to remove bone marrow from the donor's pelvic bones. This procedure, performed in the operating room under general anesthesia, takes 15-45 minutes. The donor goes home the same day. The bone marrow is then infused intravenously into the patient. Because the recipient's immune system has been destroyed prior to the transplant, the recipient is cared for in a special isolation unit for three to four weeks for protection from infections.

(ii) Peripheral stem cell harvest

Most stem cells are found in bone marrow. However, a small number of stem cells (about 1 per cent) are found in veins (the peripheral bloodstream). These stem cells are called peripheral stem cells. For a bone marrow transplant, peripheral stem cell growth is stimulated by medication, and then collected from the bloodstream by a process called apheresis. To collect the stem cells, the donor is connected to a cell separation machine. A needle is inserted into each arm. Blood is taken from one arm and circulated through the machine to remove the stem cells. The rest of the blood is then returned through the needle into the opposite arm. Apheresis is a painless procedure, which is done daily for two days. Each apheresis collection takes

five hours. After collection, the stem cells can be frozen in liquid nitrogen (cryopreserved) until needed or transfused immediately without freezing.

Graft-versus-host disease:

Rejection is not common because the recipient's immune system is suppressed. Patients who receive allogeneic bone marrow may develop a type of reverse rejection. The marrow, containing the immune system of the donor, recognizes that the recipient's immune system is different and tries to reject the "host" (recipient). This is called graft-versus-host disease. Complications can occur in the skin, stomach, or bowel, and liver function may change. Anti-rejection drugs help combat this type of rejection. When bone marrow function returns to normal and there are no signs of graft-versus-host disease, anti-rejection drugs are stopped.

Outcome:

Long-term survival may be greater than 80 per cent, but survival varies depending on the type of disease treated, the patient's age, and the severity of illness. For patients with acute leukemia, long-term survival is 50-60 per cent but this is much better than 20-25 per cent survival when patients are treated with chemotherapy alone. Children, treated early in their illness, tend to have better survival. Although infections may be more likely to occur for the first year after transplant, recipients eventually return to a normal lifestyle.



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