

Bone Marrow Transplant

Patient Information



Bone Marrow Transplant (BMT)

What is Bone Marrow Transplant (BMT)?

Bone marrow is a soft, spongy material found in the center of bones. Its key function is the formation of blood cells, including red blood cells (RBCs), which carry oxygen from lungs to tissues, white blood cells (WBCs), which fight infection and disease, and platelets which help the blood clot.

Bone marrow transplant (BMT) is a type of transfusion that replaces diseased or damaged bone marrow with healthy bone marrow, taken from the patient's own body, or from a donor.

Bone marrow transplants are used to treat people whose bone marrow stops producing enough healthy blood cells. This may become the treatment of choice for several types of disorders, including thalassemia, aplastic anemia, leukemia, lymphoma, multiple myeloma etc.

What are the Different Types of Bone Marrow Transplant?

There are two main types of BMT: Allogeneic Transplant and Autologous Transplant.

In allogeneic transplant, healthy blood cells are taken from a donor, usually a family member, to replace the diseased bone marrow in the patient.

In autologous transplant, the patient's own, healthy bone marrow is used to replace their diseased marrow. This form of transplant is preferred for patients whose bodies are producing enough healthy bone marrow cells and removes the worry of rejection of donor bone marrow, which is a risk in allogeneic transplant.

How Does Bone Marrow Transplant Work?

In BMT, healthy bone marrow is first harvested, and then infused in the patient.

Bone Marrow Harvest: The harvest process is the same for a donor and a patient whose own healthy bone marrow is being harvested (for an autologous transplant). In an allogeneic transplant, the marrow of the donor is given to patient following the harvest procedure; in an autogenic transplant marrow is frozen and stored for later use by the patient, after they undergo chemotherapy and radiation cycles, as part of their treatment plan.

The bone marrow harvest procedure is carried out in an operating room under general anesthesia and takes about 30 to 60 minutes. Special needles are used to remove the marrow from the hip bone. Once harvested, the marrow is filtered to remove fat and small pieces of bone and is then transferred to a blood transfusion bag.

If the donor's red blood cell count gets too low, a blood transfusion might be necessary, but this is seldom needed. Complications are rare, but may include infection, bleeding at the collection site, and local pain. Pain medication may administered if needed.

Bone Marrow Infusion: The day of the infusion is referred to as "day zero". Preceding days are "minus" days and days following the transplant are "plus" days. The infusion process takes place in the patient's room and is similar to a blood transfusion. It is given through a central venous catheter, which is a long, thin tube, inserted in a vein in the patient's chest or neck. This is often left in place during the entire duration of the treatment, and used to transfuse blood and infuse medicines.

The patient is given anti allergic medicine about 30 minutes prior to the transplant to help prevent any side effects. These may make the patient sleepy; this is normal. Once infusion starts, the patient's vital stats are monitored by a nurse, who remains with the patient during the entire infusion process.

What Types of Patients can be Eligible for Bone Marrow Transplant?

If it has been determined that a person can potentially be eligible for BMT, they will meet their BMT team at the Oncology Service Line of the Aga Khan University Hospital. During this meeting, their physician will begin to decide if the patient is eligible for the BMT program. The physician will review the patient's medical history and perform a physical examination. They will also discuss the purpose of the BMT plan, how it works, and what are the potentials risks and benefits.

Whether a patient can qualify for a Bone Marrow Transplant, depends on several factors:

- **Type of disease:** BMT can be used to treat a range of bone marrow/ blood diseases, disorders and cancers which are present at birth (congenital) or acquired.
- **Age:** The patient's age is a factor in the choice and eligibility of transplant the patient can received
- **Compatibility:** It is necessary to determine whether the patient's own bone marrow will be used for transplant, or whether parents, siblings, or someone else will donate, and whether they are compatible.
- **Disease status:** Whether the disease is in remission state. This determines whether the patient can be a candidate for BMT, and if so, which type.
- **Psychological state:** Whether the patient is mentally prepared and able to enter into an extensive transplant programme.
- **Overall health:** Whether the patient is free of other co-morbid such as heart or lung disease.

What is the Donor Criteria for Bone Marrow Transplant?

Healthy siblings or parents who have no major medical problems can potentially donate bone marrow to the patient. Before the procedure is done, an appointment is given to the donor to have a thorough physical examination and get the required workup to make sure that they are in good health and are a suitable match for donating bone marrow. Donors must have a tissue HLA (Human Leukocyte Antigen) type that matches the recipient. Both the donor and the recipient will be tested to ensure that their tissues matching test is acceptable.

Are there any Risks Associated with Donating Bone Marrow?

There are no significant risks associated with donating bone marrow. This is because only the required amount of bone marrow is taken from the donor which is replaced by the donor's body within a few weeks. The area where the bone marrow was taken out may feel sore for a few days, and the donor may feel tired.

The only notable risks associated with donating bone marrow are the same with any surgery and involves the use of anesthesia during the procedure. Before the bone marrow is harvested, the donor will meet with an anesthesiologist in a pre-op meeting, where all risks and precautions are explained.

What Tests Will the Patient Need Before Bone Marrow Transplant?

There are several routine tests done prior to admission. This is to make sure that the patient is physically fit to undergo bone marrow transplant. The results are also used as a baseline to measure their progress throughout hospitalisation. Some of the common tests include:

1. **Blood Test:** Complete Blood Count (CBC) and blood chemistries assist in measuring various organ functions.
2. **Chest X-ray:** X-ray of the chest views the lungs, heart and surrounding structures for abnormalities.

- 3. EKG or Electrocardiogram:** This measures the heart's electrical impulses to evaluate rhythm and function.
- 4. Echocardiogram:** This is a noninvasive diagnostic test that uses ultrasound to visualize internal cardiac structure.
- 5. CT PET:** CT PET is an X-ray technique that produces images to cross section (slices) through the body. This enables the doctor to view that inside of the body from various angles.
- 6. PFTs:** Pulmonary Function Tests are done to evaluate lung function.
- 7. Bone Marrow Biopsy:** This is a procedure to obtain samples of bone marrow for testing of bone marrow function. A needle is inserted into the posterior hip bone after local anaesthesia is given, and bone marrow is extracted through the needle.
- 8. Dental Examination:** Dental hygiene is critical as the mouth can be host to harmful bacteria, which can enter the blood stream and cause infections during compromised immunity following cancer and BMT treatment.

What Treatment Will the Patient Need Before Bone Marrow Transplant?

Chemotherapy: Chemotherapy with or without radiation therapy is given immediately prior to transplant to repress the disease prior to the transplant and suppress immune reactions.

Chemotherapy treatment consists of a group of drugs that work together. The doctor will choose the type or combinations of treatments that are best for the patient, based upon their individual needs.

Radiation: Radiation therapy may be used together with chemotherapy as part of the preparation for bone marrow transplant. Total Body Irradiation (TBI) therapy is delivered to destroy remaining diseased cells and suppress the immune system to prevent rejection of the new marrow graft.

During radiation therapy, the patient will not feel anything unusual while the machine is on. However, following the radiation cycle, immediate side effects include nausea, vomiting, decreased appetite, diarrhea, and fatigue. The skin exposed to radiation can redden and feel warm, like sunburn.

Other side effects include sores in the mouth and throat, and decreased blood cells counts. Late side effects of radiation can include sterility, cataract formation and lung problems (discussed below).

Blood Transfusion: When blood counts are low in patients, blood transfusions may become necessary. With WBC counts, patients may become susceptible to infections, so their temperature is monitored closely and intravenous antibiotics are started if needed.

The decision to give a blood product is made only after careful consideration. In making this decision, the doctor will balance the risk of carrying out a blood transfusion against the risk of not doing so. If a blood transfusion is needed, the doctor will explain why it is necessary.

Some risks of blood transfusions include risk of catching an infection and developing a fever or rash, which is usually due to immune reaction or allergy, and can be managed with medicines or slowing down the transfusion process.

What Happens in the Days Following Bone Marrow Transplant?

After the transplant, the patient's blood counts are checked daily to monitor engraftment. This is the process which occurs when the transplanted bone marrow travels to the cavities of the large bones and begins producing new WBCs, RBCs, and platelets. Engraftment usually occurs after 10 days of transplant; however, each patient is different, and the time it may take to engraft varies from person to person.

While the new bone marrow produces enough blood cells to support the body, the patient may continue to receive blood or blood product transfusions.

After the transplant, the patient remains in the hospital until their blood counts recover and they are able to eat and drink adequately. The average stay for BMT patients is approximately 3-4 weeks,

when there are no complications following the transplant. Again, this duration may vary patient to patient.

What are the Potential Psychosocial Risks of Bone Marrow Transplant?

Below are some potential psychosocial risks patient may experience during the stay in the BMT unit and undergoing bone marrow transplantation:

- Anxiety
- Depression
- Loneliness
- Stress
- Intense fear
- Frustration

Family support and optimism throughout the stay in BMT unit will help in managing these risks. Encourage the patient to focus on ways to feel good about what they are doing to get better. Try to find ways to treat the patient with little things which make them feel good and relieve stress.

What Care Must Be Taken After Bone Marrow Transplant?

Patients who have had BMT are at an increased risk of infections because of compromised immunity. Infections can be the result of exposure to the environment including air, food, water, and other people, as well as from one's own body.

Following the procedure, it is important that the patient, or anyone who enters the patient's room in the Bone Marrow Transplant (BMT) Unit, pays close attention to the following guidelines:

- Only one visitor is allowed in the BMT Unit room at any one point.
- Anyone entering the room must wash their hands and wear a mask to protect the patient from infection.
- Fresh flowers, dried flower arrangements and live plants are not allowed in the BMT unit at any time.
- Sterile hospital clothes are provided and should be changed every day after a shower.
- The patient must take a balanced diet and follow the guidelines of their nutritionist.

Everyone has bacteria on their skin, in their mouth, stomach, intestinal tract and perineal area. This is normal and helps protect one from infection. However, when one's immune system is suppressed and does not work as it should, bacteria may overgrow and cause harmful infections. To minimise this risk, patients should:

- Be sure to shower every day. Bathing helps keep bacteria away from growing on the skin. Special attention is needed to areas that become moist (underarms and between and under skin folds). Rinse off the soap thoroughly as soap can be drying. Apply lotion or oil to help prevent dry skin.
- To soothe the mouth and keep it clean, mouth wash and Nilstat will be prescribed.
- Antibiotics may be prescribed as per physician's order to reduce the risk of infection.

What are the Complications of Bone Marrow Transplant?

The two or four weeks immediately following BMT are the most critical. During this time, the patient is at an increased risk of developing infection and excessive bleeding.

Blood samples are taken daily to determine whether or not engraftment has started and to monitor organ function. When the transplanted bone marrow finally engrafts and begins producing normal blood cells, the patient is gradually taken off antibiotics, and blood and platelets transfusion is generally no longer required.

Early complications following BMT:

Infection: Following a BMT, the white blood cells in the body are at their lowest, until the new marrow begins to function. Therefore, the patient is more susceptible to infection during this time. Medications are given to control any infection.

Mucositis: This is injury of the mucosal lining of the mouth and gut and is very painful, and prevents eating and drinking. Mucositis is treated with pain medications plus intravenous infusions to prevent dehydration and malnutrition.

Graft vs. Host Disease (GVHD): This complication is seen in allogeneic transplants where donor marrow is used in BMT. It occurs when donor cells attack the patient's tissues or organs, considering them as foreign bodies. GVHD can develop any time, but the risk is higher when new marrow first starts developing. Some signs of GVHD include change in the skin, liver and/or gastrointestinal tract.

Doctors will prescribe immunosuppressive drugs to suppress cells which are recognized as foreign in the body. While on these suppressive medicines, patients are at an increased risk of life-threatening infections. Nurses will review precautions with patients to prevent infection (also listed above). Patients and their attendants must be vigilant for signs of infection, and notify the doctor immediately at the first sign of infection.

Bleeding: Problems with bleeding may also develop when the platelets count is too low. Platelets transfusion is carried out help control bleeding.

Kidney & Liver Problems: BMT patients are on several medicines throughout their hospitalization. Most of these medications are metabolized in the liver and excreted through the kidneys and may cause problems. Blood tests are regularly carried out to closely monitor the kidney and liver function. The doses of medication are then adjusted accordingly. Another problem that may develop in the liver is Veno-Occlusive Disease (VOD). This causes obstruction and blood flow from the liver. It is often a reversible condition; however in some cases it may be life threatening.

Graft Failure: If the new bone marrow doesn't function adequately and the blood cell counts do not rise, it is considered a graft failure. This occurs in about 10% of the patients. In this case, the doctor will discuss any possible further treatment options.

Long term complications following BMT:

Late complications can be caused by high-dose chemotherapy, radiation therapy, chronic GVHD, or problems resulting from the original disease. Some of the long-term side effects include:

Gonadal Dysfunction: Sterility, the inability to have children, is a potential side effect in patients receiving high dose chemotherapy and radiation. However, treatment does not affect sexual function and sperm banking prior to treatment is offered.

In females, potential physical changes include decreased or absent menstrual periods, decreased vaginal secretions, and decreased hormone (estrogen) levels. A discussion with the gynaecologist is recommended before start of chemotherapy and radiation treatment.

Cataracts: Patients who have received total body irradiation or radiotherapy to the whole body, may experience cataract formation after their BMT. Cataracts can be operated on as soon as they develop.

Pulmonary Complications: Long-term survivors of transplantation may develop pulmonary (lung) abnormalities due to high-dose chemotherapy, radiation and chronic GVHD.

Rejection: This complication is related to allogeneic transplant, where the host body rejects donor cells. The period of risk is usually 2 to 4 months after transplant.

Relapse: Relapse remains a major problem associated with bone marrow transplant. Relapse may occur any time following BMT; however the risk decreases after 2 years.

Bleeding: Platelets are one of the last types of blood cells to return to normal level after transplant. It might take several weeks or months for the new bone marrow to make enough platelets so the patient no longer requires platelets transfusion. Signs of a low platelet count may include:

1. Excessive bruising
2. Petechiae (pinpoint red spots on the skin)
3. Bleeding gums
4. Nose bleeds
5. Blood in stool
6. Blood in urine

Infections: Herpes simplex and Herpes zoster are common viral infections that occur post-transplant. They usually appear as sores on the lips or in the mouth or small blisters on the lips, face or back. They may cause itching, pain and fever.

Secondary Malignancy: The risk of another type of cancer resulting from radiation and chemotherapy that accompany BMT has been documented in a small number of patients.

Chronic Graft Versus Host Disease (GVHD): Chronic GVHD occurs later than acute GVHD (which usually occurs during the first 100 days of the transplant) and may affect sites different from those affected by acute GVHD. Diagnostic tests for chronic GVHD may include biopsy of the skin and/or oral mucosa, pulmonary function studies, and liver function tests. Treatment of chronic GVHD generally includes immunosuppressive therapy (Prednisone, Cyclosporine), and antibiotics to prevent infections.

Oral Mucosa: The inside of the mouth is often affected by BMT in the long term. Symptoms include taste changes, dry mouth, and inflammation, redness and ulceration of the mouth and tongue. Oral chronic GVHD may cause mucous membrane to appear white. Self-care measures include:

- Practicing good mouth care for relieving inflammation
- Avoiding mouthwashes that contain alcohol because they sting and irritate the mouth
- Keeping the lips lubricated to prevent cracking and bleeding.

Lungs: Lung problems may be associated with chronic GVHD. This includes compromised ability of the lungs to transfer oxygen which can cause shortness of breath. Self-care measures include:

- Participating in a pulmonary rehabilitation program
- Giving up smoking and avoiding all respiratory irritants
- Staying indoors on cloudy days

Esophagus and Gastrointestinal Tracts: The lining of the esophagus and G.I tract is often affected. Symptoms may include painful and/or difficult swallowing and sometimes pain beneath the breast bone. Self-care measures include:

- Eating small meals frequently and drinking lots of fluid
- Receiving follow-up care from a gastroenterologist
- Eating a balanced diet can help by:
 - Making you feel better
 - Improving your nutritional status

- Reducing treatment side effects
- Decreasing the risk of infection
- Making your healing and recovery faster.

What are the Discharge and Follow-up Instructions?

Upon discharge from the hospital, special care instructions will be given, and the patient will be closely followed-up with for approximately 100 days after the transplant.

Some key discharge instructions that need to be strictly followed are:

Activity/Exercise: It is important to not do any forceful exercises such as weightlifting or sports following BMT. It is advisable to gradually increase the level of activity and rest in between activities.

Diet: Healthy and well balanced diet will be explained by the nutritionist and/or nurse. The patient should:

1. Weigh themselves daily at the same time every day. Any weight change of 5 pounds or more in one day should be reported.
2. Drink at least 3 liters of fluid a day unless restricted.
3. Eat thick skinned fruit only (melons, bananas, oranges, and grapefruit) which can be peeled. All canned fruits are also allowed.
4. Have fresh, well cooked vegetables and avoid raw vegetables, and spring water.
5. Autologous transplant patients may have pasteurized milk and dairy products if tolerated, but avoid aged dairy products (such as cheese) unless properly cooked.
6. Allogenic transplant patients may have a small amount of chocolate milk when taking Cyclosporin. They should avoid all other dairy products.

Sexual Activity: Following transplant, the patient's sex drive may be lower than normal. This is temporary and will return.

Hygiene - Mouth care: While tap water can be used, it should not be swallowed. Care must be taken to brush after each meal and at bed time and use only prescribed mouthwashes. No toothpaste or mouthwash should be swallowed, with the exception of. The doctor must be informed of any change in the mouth (increased dryness, bleeding or sores).

Hygiene - Bathing: The patient may shower as usual, but use only mild soaps and shampoos and avoid medicated or heavily perfumed products.

Skin Care: They may use gentle skin moisturizers, make-up, aftershave and perfumes in small quantities, and stop if a skin reaction develops. Care must be taken to stay out of direct sun for at least one year. Use of sun protection factor (SPF) greater than 15 is recommended, as is wearing a hat and long sleeve shirts when outside.

Home Environment: It is advisable to wear a mask when visiting the clinic, being around any construction, when driving with two or more persons in the car, or when in a crowd. Where possible, it is also advisable to stay away from interacting with too many people and especially anyone who is sick. Other recommendations include avoiding dust and leaving the room when cleaning is being done and changing air conditioner filters as recommended by the manufacturer.

Medications: Patients are required to take medications following their bone marrow transplant. It is important to know the name, dosage, purpose, possible side effects of all medications, and what to do in case of side effects; not use aspirin or aspirin-containing products before checking with the doctor; storing medications properly, avoiding areas that are very warm, moist or in direct sunlight.

What are the Reportable Signs and Symptoms?

Patients must report to the Emergency Department or the Clinic in case of the following signs and symptoms:

- Temperature greater than 38.3°C or 101°F
- Persistent cough (note any sputum production and color)
- Shortness of breath and/or excessive fatigue
- Blood in urine, stool or sputum or bleeding from gums and nose
- Feeling dizzy or light-headed
- Nausea or vomiting not relieved by anti-nausea medications
- Difficulty emptying bladder, burning or urination, constipation or diarrhea.
- Any other cause of concern.

What is the Post Discharge Follow-up Schedule after Bone Marrow Transplant?

BMT patients are required to visit their doctor regularly for a few months:

- Weekly for four weeks
- Fortnightly for one month or as required

What Immunization is Needed after Bone Marrow Transplant?

One year post-transplant, the body will be able to develop antibodies to inactivated vaccines and at the one year follow-up evaluation, the BMT physician will order several vaccines to give protection against dangerous bacteria.