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We have put together this Transplant Module to help patients, their families and caregivers learn about blood and marrow transplantation. There are many caring and knowledgeable people on your health care team to help you through the transplant, address your concerns and answer your questions. Please do not hesitate to speak to them!

Blood and marrow transplantation is a treatment for many diseases in both adults and children. Bone marrow is the spongy tissue found inside your large bones and is responsible for making blood cells. These blood cells include your platelets, white blood cells and red blood cells. The bone marrow is also home to the immune system. All of these cells are very important, so a change in marrow function can have serious side effects.

The term blood and marrow transplant, or BMT, has been used for many years. You are, however, likely to hear some different terms. All of these fall into the category commonly described as blood and marrow transplant. Some of these terms are:

- Peripheral blood stem cell transplant
- Blood stem cell transplant
- Blood progenitor cell transplant
- Blood stem cell and bone marrow re-infusion

The difference in these terms has to do with what is actually transplanted and where the cells come from. You can read more about this in Transplant Basics in the next section.

For simplicity, blood and marrow transplant, or BMT, will be the term used here for all types of blood and marrow transplant. As well, the terms bone marrow and stem cells will be used interchangeably.
Transplant Basics

Types of Blood & Marrow Transplant

Blood and marrow transplant or BMT is used to treat a variety of disease but its basic purpose is the same. BMT is used to replace a malfunctioning or non-functioning bone marrow with a healthy, functioning marrow.

Before the transplant, patients undergo conditioning treatment with chemotherapy and/or total body irradiation (TBI). This conditioning treatment is used to eliminate the underlying disease, create space for the new marrow and prevent rejection of the new bone marrow. Following the conditioning treatment, patients undergo BMT to restore healthy bone marrow functioning.

There are different types of transplants depending on who donates the bone marrow or blood stem cells. They are:

1. **Autologous Transplant.** The patients donate their own stem cells prior to treatment for re-infusion later.

2. **Allogeneic Transplant.** Stem cells are donated from an acceptably matched family member (usually a brother or a sister) or an unrelated donor.

3. **Volunteer Unrelated Transplant.** Stem cells are donated by someone who is not related to you. The anonymous donor is found in the Canadian or worldwide donor registries.

4. **Syngeneic Transplant.** The person donating the stem cells is an identical twin.

Your BMT doctor will discuss in detail what type of transplant is recommended for you.

What are stem cells?

Blood cells grow in the same way as other human cells. They develop in the bone marrow from a parent cell known as a stem cell. Stem cells are immature cells that can develop into all of the different types of blood cells: white blood cells, red blood cells and platelets. Stem cells are usually

There are four types of transplant:

- Autologous
- Allogenic
- Volunteer Unrelated
- Syngeneic
found inside the bone marrow spaces of large bones. They can also travel from one bone to another by way of the blood stream.

In a blood and marrow transplant, stem cells are harvested, either from the large bones or from the blood stream, and transplanted to the patient. Stem cells collected from the pelvic bone in the lower back are called bone marrow. Stem cells harvested from the blood in the veins are called peripheral blood progenitor cells. This is why blood and marrow transplants are often referred to as blood stem cell transplants. For simplicity, we will use the terms bone marrow and stem cells interchangeably in this manual.

Your BMT doctor will discuss how stem cells will be collected from you or your donor.

**How are stem cells collected?**

There are two different methods to collect stem cells.

1. **Peripheral Blood Stem Cell Collection.** Stem cells can be collected from the blood. This procedure is called a peripheral blood stem cell collection. This technique does not require surgery. It does, however, involve a few more steps than a conventional bone marrow harvest. Prior to the collection, the donor or autologous transplant patient is given a medication to promote the growth and release of stem cells from the bone into the blood. The stem cells are then collected using a special machine called a Cell Separator. This technique has dramatically increased in popularity over the last ten years. Stem cells are generally collected using this method here at the Leukemia/BMT Program of BC.

2. **Bone Marrow Harvest.** Stem cells can be collected directly from the bone marrow spaces, most often from the pelvic bones. Several puncture sites are made along the bone and the cells are removed using a needle. This procedure is known as a bone marrow harvest. This technique is used less often here at the Leukemia/BMT Program of BC.
Specific Section for
Autologous Transplant Patients

Leukemia / Bone Marrow Transplant (BMT)
Program of British Columbia
Autologous transplant refers to stem cells or bone marrow that are collected from the patient and then given back (re-infused) to the same individual in the transplant process. This requires the patient to undergo either a bone marrow harvest or a peripheral blood stem cell collection.

This section provides an in-depth look at what is involved in a peripheral blood stem cell collection for autologous transplant patients.

Peripheral blood stem cell collection for autologous transplant patients involves the following steps:

1. Vein assessment
2. G-CSF administration
3. Actual collection of peripheral blood stem cells

**Vein Assessment**

**What to Expect**

A vein assessment is necessary to ensure that the patient has strong veins with good blood flow for the blood stem cell collection procedure.

An appointment will be made for you to go to the Vancouver General Hospital Hematology Apheresis Unit, also referred to as the HAU. The HAU is located at the Krall Centre on the 6th floor of the Centennial Pavilion.

On your first visit to the HAU, you will be given a tour of the unit. The process of stem cell collection will be explained and shown to you.

A nurse will check your arm veins located in the elbow area to ensure that they can be used for the stem cell collection procedure. The Cell Separator machine needs a certain amount of blood flow in order to work properly. Therefore, a strong vein with good blood flow is needed.

If the veins are too small or delicate, the insertion of a temporary intravenous line called a “St Paul’s Catheter” may be necessary. A St. Paul’s Catheter is a small plastic tube that is placed into a large vein located in the side of the neck. Sometimes it is necessary (but rare) to place the St. Paul’s Catheter in the large groin vein, which drains the blood from the legs. This tube allows the blood to be easily removed and returned to your body. If you require a St. Paul’s Catheter, the nurse will make an appointment for you with the Angio-Radiology Department. The St. Paul’s Catheter will be inserted the day before or the day of the stem cell collection. The catheter will be removed after the collections are completed.

The nurses and doctors at the HAU wish to make the collection experience as stress-free and comfortable as possible. Please let them know if there is anything they can do to assist you in this.
G-CSF Administration

Frequently Asked Questions - FAQs

What is G-CSF?

G-CSF is a colony stimulating factor. Colony stimulating factors are naturally occurring special proteins in the human body that stimulate blood cell production and growth. G-CSF helps increase the number of stem cells in your blood stream.

These naturally occurring proteins can also be manufactured as a drug. The G-CSF used in our Program is Neupogen®. The generic name is filgrastim.

Why is G-CSF given?

In order to limit the number of times you have to undergo stem cell collection, the BMT doctor will try to move your stem cells out of your bone marrow and into your blood stream. This process is called mobilization. The G-CSF you will receive will encourage the growth of stem cells in your body and mobilize them into your blood stream for collection.

How will it help my transplant?

Engraftment is the process by which re-infused stem cells grow in the bone marrow and manufacture new blood cells. After your stem cells are re-infused, engraftment is the indication that the new stem cells are working properly. Research has shown that stem cells that have been mobilized engraft faster than stem cells collected directly from the bone marrow.

How much does G-CSF (Neupogen®) cost?

G-CSF is a very expensive prescription medication and is not paid for by the Vancouver General Hospital or the BC Cancer Agency for the autologous transplant patient. Unfortunately, this is the only medication that can be used to increase blood stem cells. Generally, the cost of G-CSF for one course of treatment is between $3,000.00 and $3,800.00.
Here is what you need to know:

1. You should be registered for BC Fair PharmaCare. You can contact Fair PharmaCare (1-800-663-7100) to clarify your benefit plan and medication coverage. If you have already reached your deductible amount with Fair PharmaCare, in the present calendar year, the cost of your G-CSF may be greatly reduced.

2. Depending on your extended health plan and your Fair PharmaCare deductible, you will need to pay for some or this entire amount “out-of-pocket”.

3. You may have drug cost reimbursement through an extended health plan or funding from social assistance (Ministry of Human Resources). You should contact the insurance carrier or your financial aid worker to discuss coverage of this medication.

4. If you have tried all the above and still cannot afford the medication, please contact the L/BMT Coordinator or the L/BMT Social Worker assigned to you, to discuss this situation further.

**How is G-CSF given?**

G-CSF will be administered daily by injection through a tiny needle under the skin. Arrangements will be made for you to receive your injections either in the Hematology Apheresis Unit, the L/BMT Daycare Unit or if you prefer you may arrange to have them given at your family doctor’s office or walk-in clinic near your home.

Generally, you will take G-CSF for 5 days. Stem cell collection will commence on the 4th day. On the 5th day you will have an early appointment to come to the Hematology Apheresis Unit (HAU) and have your blood drawn in order to check your blood counts. Assuming your neutrophil count is sufficiently high, you will proceed to have your peripheral stem cells collected. If your counts are not elevated enough, you may be prescribed additional days of G-CSF therapy.

**What should I expect when injecting G-CSF?**

When G-CSF is injected, you may feel a slight stinging sensation at the injection site. Sometimes, injecting into a larger surface area such as the abdomen or injecting the medication slower can reduce the stinging. If you experience some pain or redness at the injection site, it should go away soon. If it does not, contact your nurse or doctor.

Sometimes a “bump” occurs at the injection site. **Do not rub it.** The bump will often go away within a few hours. If the bump persists for more than a few hours, contact your nurse or doctor.

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**Other drugs may interact with G-CSF:** It is important that you tell your doctor if you are taking any other medications. This includes over-the-counter drugs, naturopath/herbal remedies, vitamins, teas, etc.
A small amount of medication can sometimes leak out at the injection site when the needle is withdrawn. If it does, simply apply light pressure with an alcohol swab, but do not rub the area.

Other drugs may interact with G-CSF. It is important that you tell your doctor if you are taking any other medications. This includes over-the-counter drugs, naturopath/herbal remedies, vitamins, teas, etc. Inform your doctor even if you only take these occasionally.

**What are the side effects of G-CSF?**

Generally, G-CSF is well tolerated. Some patients have experienced discomfort that is usually reported as headache and/or aching in the bones, most often in the back and hips. If you feel discomfort, please contact your doctor or nurse for advice on how best to relieve it. Be sure to tell your nurse or doctor if you experience any symptoms that concern you while you are taking G-CSF. Never take a medication for a side effect, or for anything else, unless your nurse or doctor recommends it.

**The Collection of Peripheral Blood Stem Cells**

**What to Expect**

Your stem cells will most likely be collected by a procedure called **apheresis** (a-fair-ee-sis). Two ends of tubing will connect you to a cell separator machine during the collection. Your blood will flow out of one arm, inside the tubing, to the machine where it will spin your blood around at high speed. The spinning separates the different components of the blood into layers based on their weight. The stem cell layer will then be collected and the remaining blood will be returned to you via the other arm. The blood always stays inside the tubing set. The tubing and needles are sterile. They are used only once and then discarded.

You will be attached to the cell separator machine for 4–6 hours for each collection. There will be nurses and technicians present for the entire time. During the procedure it is necessary for you to stay in bed. Each bed area has a television set to help you pass the time. You may also have a friend stay with you.

**Side Effects During the Apheresis Procedure**

The apheresis procedure is safe. However, there are some side effects you may experience and should be aware of:

- If you have an IV (intravenous) needle in the inside elbow region of your arm(s) you will need to keep your arm(s) straight during the procedure. Sometimes this can be uncomfortable. Please let the nurses know so that they can assist you in getting as comfortable as possible.
You may start to feel light-headed, nauseated, cold or experience muscle cramping or tingling around the lips, hands or feet. Tell the nurses immediately.

- The flow of blood from your veins can sometimes be slow and variable. In this case, the nurses may ask you to squeeze your hands to increase blood flow, change your arm position, or the nurses may adjust the lines or machine. Occasionally a needle will have to be replaced in order to get better blood flow.
- Changes in blood volume may make some people feel dizzy or light-headed. You should tell the nurses immediately if you feel anything like this.
- An anticoagulant (anti-clotting) drug is mixed with your blood as it enters the machine to keep it from clotting during the procedure. This may cause a sour taste in your mouth. The anticoagulant can also lower your blood calcium and you may experience light-headedness, nausea, muscle cramping, and/or a tingling feeling around the lips, hands or feet. You should tell the nurses immediately if you feel any of these symptoms. Oral or intravenous calcium will bring quick relief of these side effects.
- You may start to feel cold during the procedure. If you feel chilled, please let the nurses know. They can give you extra blankets and heating pads to keep you warm and comfortable.

Frequency of Stem Cell Collections

The goal is to collect enough cells for one transplant. Your physician will have discussed this with you prior to your treatment. The targeted cell collection is usually achieved in 1 to 2 days. Occasionally a third day of collecting is required. The number of stem cell collections needed largely depends on the patient’s weight and response to the G-CSF and the apheresis procedure.

Immediately after the apheresis procedure is completed, specimens are obtained from the bag of collected stem cells. These are sent as soon as possible to a special lab where the sample will be studied and the actual stem cell count will be determined. Results of this analysis will usually be completed by 4:00 pm that same day. Once the actual count is known and reviewed by the doctor, you will be notified as to whether more stem cell collections are needed on subsequent days.
Processing the Stem Cell Collection

In order to preserve the stem cells, they will need to be frozen. This process is called cryopreservation. Shortly after the stem cells are collected, they are sent to a special lab called the Clinical Call Therapy Lab. There, the stem cells will be concentrated and a preservative will be added to protect the cells from the freezing process. They will then be stored in a special freezing vault until the time you need them.

Storage of Stem Cells

Under the new policy, stem cells older than 7 years will be discarded or donated to the Canadian Blood Services with the patient’s consent and knowledge. The quality of the stem cell after such a long period of storage is uncertain. Your BMT doctor will discuss this in detail with you.

When to Call the Doctor

Never hesitate to call the doctor or nurse if you have any symptoms that worry you or if you are concerned with any aspect of your treatment. However, contact the doctor or nurse immediately if you:

• Have a fever of 38°C (100°F) or higher
• Have chills
• Develop a rash or symptoms of an allergic reaction
• Pain when urinating
• Are bleeding, or have a problem such as a lump, swelling or bruising at the injection site that doesn’t go away
• Notice anything unusual about your condition

Important Reminders

Things to keep in mind:

1. The Hematology Apheresis Unit (HAU) can be reached at 604-875-4626.
2. Appointment times for stem cell collections at the HAU are usually between 8:00 am and 9:00 am.
3. The entire process can take up to 4–6 hours from start to finish. This makes for a very long day. You may wish to bring your own lunch and snacks. The HAU can provide juice, cookies and a limited selection of sandwiches.

4. It is very important that you have breakfast before coming to the unit, preferably one that is rich in calcium.

5. Do not drink coffee or tea before the procedure, as you will not be able to get up to use the washroom once you are hooked up to the cell separator machine.

6. Please use the washroom facilities in the HAU just before the procedure begins. If you need to go to the bathroom during the procedure, bedpans are available. A nurse will help you with this. It is recommended that you wear comfortable and loose fitting clothing (i.e., pants with an elastic waistband may make things easier).

7. You will have your own television available for your use during the apheresis procedure. Also, unless you have a St. Paul’s Catheter, reading materials would be inappropriate to bring, as you will not have the use of your arms.

8. Once the procedure has started, the nurses will allow one visitor to stay with you.

9. It is very important to notify the nurses right away if you feel light-headed, dizzy, nauseated, cold, or have tingling around the lips, fingers or toes, during the procedure. Slowing or stopping the procedure for a short time can sometimes resolve some of
Phases of BMT:
Autologous & Allogenic Transplants

Leukemia / Bone Marrow Transplant (BMT)
Program of British Columbia
Autologous and allogeneic blood and marrow transplants usually follow these four phases:

1. Pre-BMT Phase
2. BMT Phase
3. Post-BMT Phase
4. Discharge

**Pre-BMT Phase**

### Diagnostic Tests

Many diagnostic tests are done prior to having a blood and marrow transplant. Some patients will have these tests completed before they are admitted to hospital. Others will have the tests completed soon after admission. This will depend upon the admission date and the schedule that has been set up for each patient. Tests that have to be completed on most patients prior to a BMT are:

- Blood tests, including testing for exposure to hepatitis and HIV (the AIDS virus)
- Bone marrow biopsy
- Chest x-ray
- Dental x-ray
- Electrocardiogram (ECG)
- A heart function study (RVG)
- Lung function tests (PFTs)

To learn more about these tests, refer to Diagnostic Tests & Procedures in the Core Module.

### Hickman® Line Insertion

It is also during the Pre-BMT Phase that a special intravenous line known as a Hickman® line may be inserted. The Hickman line® is an intravenous device that is used to give fluids, blood transfusions, medications, and the blood stem cells during the re-infusion process. Some patients may already have a central venous line when they are admitted to the hospital. Others will have their Hickman® line inserted within 1–2 days of admission.

To learn more about the Hickman® line insertion procedure, refer to Diagnostic Tests & Procedures in
Conditioning Treatment

What is conditioning treatment?

Conditioning treatment is used to eliminate the underlying disease, create space for the new marrow and prevent rejection of the new bone marrow.

Once the conditioning treatment has begun, patients usually need to be in protective isolation to help prevent infection. Protective isolation means that it is necessary for the patient to remain in the hospital room or ward most of the time. However, there are circumstances when patients must leave the hospital room or ward to have tests in other departments. Protective isolation continues throughout transplant and for about three weeks post transplant, until the patient’s condition and white blood cell count have improved to a satisfactory level.

Types of Conditioning Treatment

There is a variety of conditioning regimens that involve chemotherapy alone, or a combination of chemotherapy and total body irradiation (TBI). Your BMT doctor will provide detailed information about the particular conditioning treatment that is recommended for you.

1. **Chemotherapy.** All patients will receive chemotherapy drugs prior to the blood and marrow transplant. The chemotherapy is given in high doses in order to eliminate the disease or cancer. In the case of an allogeneic (donor) BMT, chemotherapy suppresses the immune system to allow the transplanted bone marrow to undergo a process called engraftment. Chemotherapy is administered by a nurse in the patient’s hospital room through the Hickman® line. Your physician will discuss the possible side effects of chemotherapy in detail with you.

   To read more about chemotherapy agents and the possible side effects and complications from chemotherapy agents, refer to the Chemotherapy Module.

2. **Total Body Irradiation (TBI).** Some patients will receive radiation therapy in addition to chemotherapy during their conditioning treatment. Like chemotherapy, total body irradiation (TBI) is used to eliminate the disease and in the case of allogeneic (donor) transplant, to suppress the patient’s immune system in preparation for the transplanted stem cells. TBI is given in the Radiotherapy Department at the British Columbia Cancer Agency. Before receiving TBI, patients go to the Radiotherapy Department for a pre-treatment appointment. The purpose of this appointment is to take special measurements of height, weight, and body thickness so that
the radiation treatments can be tailored to each individual patient. A number of special markings are placed on the skin at this time to serve as landmarks when the treatment begins. This planning appointment is an excellent time to meet the staff in the Radiotherapy Department and to ask any questions. We suggest that you write your questions down and bring it to your appointment.

To read more about total body irradiation and possible side effects and complications, refer to the Chemotherapy Module.
BMT Phase

The Transplant Process

What actually happens in the transplant?

Once the conditioning treatment is completed, you are ready to receive the donor’s or your own blood stem cells/bone marrow. The BMT Phase is the shortest phase. The process consists of the infusion of the stem cells. At this point, patients are often relieved that the conditioning treatment is over, and excited by the fact that the transplant can now take place. The day of your transplant will be referred to as “Day 0”.

Most people are surprised that the actual infusion of stem cells is a very straightforward procedure. The stem cells enter the patient’s blood stream through the Hickman® line. Much like a blood transfusion, the stem cell infusion process takes anywhere between 20 minutes to a couple of hours.

A nurse will be in the room for the entire transplant and a doctor will be present for the beginning and then available on the unit for the remainder of the transplant.

Side Effects

Patients do not generally experience any significant side effects from the actual stem cell / bone marrow infusion. Some people develop chills, rashes, a fast pulse rate, or high blood pressure. However, each of these symptoms is carefully monitored and treated as necessary.

A nurse will be in the room for the entire transplant and a doctor will be present for the beginning and then available on the unit for the remainder of the transplant.

Specific to Autologous Transplant

If you are undergoing an autologous transplant, i.e., receiving your own stem cells, your stem cells would have to be frozen and then thawed prior to the transplant. To protect the stem cells while they are frozen, a preservative called DMSO (Dimethyl Sulfoxide) is used. During and after the transplant, you may experience some side effects from DMSO.

The DMSO may cause you to have a garlic-like (or oyster/cream of corn-like) taste in your mouth that will last a few days. Some patients find it beneficial to chew gum or suck on hard candies to lessen this effect during the infusion. Occasionally, DMSO can cause nausea, shortness of breath, wheezing, stomach pains, lowered heart rate, or allergic reaction. You will be given medication before the transplant to help prevent
them from occurring. Although not due to DMSO, your urine may become red-coloured for 24 hours after
the infusion. A nurse will be in your room during the entire transplant to monitor you closely. A doctor will
be present for the beginning and then available on the unit for the remainder of the transplant.

Notes
It is during the Post-BMT Phase that everyone looks forward to evidence that the transplanted stem cells have travelled to the right place and are starting to work.

**Post-BMT Phase**

**Engraftment**

*What is engraftment?*

The Post-BMT Phase is the longest phase of a blood and marrow transplant. It begins following the stem cell / bone marrow infusion, and continues throughout the recovery period.

It is during the Post-BMT Phase that everyone looks forward to evidence that the transplanted stem cells have travelled to the right place and are starting to work. Engraftment is the process in which the transplanted stem cells find their way to the bone marrow spaces in the centre of the large bones of the body. Only then can the transplanted stem cells begin to produce new blood cells.

Experts are not completely certain how this amazing process happens. It takes approximately two to four weeks after the stem cell / bone marrow is infused for engraftment to occur.

There are several ways that your doctor can tell that engraftment has begun. The first sign of engraftment is the gradual rise of white blood cell count or platelet count that begins about two weeks after your BMT day. Red blood cells often take a little longer to begin developing.

**Graft-Versus-Host-Disease (GVHD)**

Graft-versus-host disease or GVHD is a term used to describe a battle between the transplanted stem cells and the patient’s body. This is a complication that occurs when the new stem cells (the graft) reject or see your body (the host) as foreign.

While GVHD is extremely rare in autologous transplants, it occurs in approximately 50% of patients who have an allogeneic (donor) transplant. GVHD is less likely to occur if the donor and recipient are matched – have identical tissue or “HLA” types. The condition is considerably more common when the match is only partial or if the donor and recipient are unrelated. All patients receiving bone marrow from a donor, unless the donor is an identical twin, will receive drugs to try to prevent GVHD.

Of those who develop GVHD, many will experience only minor difficulties. About half will experience significant problems. There are two types of GVHD: acute and chronic.

**Acute GVHD**

Acute GVHD may occur early when the bone marrow starts to engraft around two to four weeks after the transplant. Acute GVHD may involve three main body systems:
1. **Skin GVHD** usually shows up as a rash anywhere on the skin surface but it is mostly seen on the hands, feet, abdomen and face. The skin initially looks sun-burnt. The rash may progress to other areas of the body and potentially become a blister-like rash.

2. **Liver GVHD** becomes evident in your bloodwork. Bloodwork is done regularly to test how your liver is functioning. With liver GVHD, these results become elevated. Liver GVHD may also cause the patient to become jaundiced (to have a yellow tone to the skin).

3. **Gastrointestinal Tract GVHD** appears as nausea and vomiting and/or acute, watery or sometimes explosive diarrhea. The amount of diarrhea can indicate the severity of the GVHD. An exam of the gastrointestinal tract is also done to confirm GVHD.

**Chronic GVHD**

Chronic GVHD occurs after 100 days post-BMT. It may develop as a continuation of acute GVHD or occur without any prior history of acute GVHD. Chronic GVHD is usually less serious. It is most frequently associated with soreness or dryness of the mouth or eyes, lung and liver complications, changes in skin pigmentation. It may also cause hair loss, weight loss, vaginal dryness, cough, shortness of breath and joint problems.

**Management**

To manage and treat GVHD, a number of drugs such as cyclosporine, methotrexate and prednisone are used early on to help prevent or minimize GVHD. However, some side effects of the drugs can interfere with the patients’ quality of life. Your BMT doctor will discuss these with you in detail.

GVHD is not always a negative development following a blood and bone marrow transplant. This is because the immune system that attacks the host causing GVHD is also known to attack cancer cells. Researchers have found that patients with GVHD generally have a lower risk of having a relapse of their cancer.
Managing Low White Cell Counts

Overview

In a healthy individual, white blood cells provide protection against infections caused by bacteria, viruses and fungi. There are several different types of white blood cells, but neutrophils are the most common type. Neutrophils fight infection by rapidly increasing in number when an infection occurs. They then surround and destroy the infection. Your “absolute neutrophil count” (ANC) is monitored closely after your treatment to give us an indication of your ability to fight infection and to indicate the beginnings of engraftment.

After receiving your transplant, your white blood cell count will decrease quickly and will remain low until the new cells begin to grow (engraftment). During this time, you are at great risk for developing an infection since you will not have white blood cells to fight bacteria, viruses or fungi. Although the risk of infection decreases as the immune system recovers (white blood cell count rises), BMT patients must continue to take protective measures until their bone marrow has fully recovered. Recovery on average takes 6–12 months after the transplant.

Precautions Against Infections

Many precautions are taken to prevent infection in bone marrow transplant patients. For example, the protective isolation procedures and guidelines for visitors are for the purpose of preventing infection while you are in hospital. For a complete guideline on how to prevent infections, refer to Your Responsibilities in the Core Manual.

Signs of Infection & Management

One of the most common signs of infection is a fever. Most BMT patients will have an increase in temperature that may signal an infection at some point during their transplant experience. Infections

- Fever of greater or equal to 38°C (Celsius) or 100°F (Fahrenheit)
- Skin tenderness
- Chills/sweating
- A burning feeling when urinating
- Rectal pain/tenderness
- A cough, sore throat or mouth pain
can occur at any time prior to, during, and after the transplant. Because all people carry germs (organisms) in their systems naturally, infections in the transplant patient are often from the patient’s own organisms. Although infections can be quite serious, there are many approaches to treatment. Anti-bacterial, anti-viral and sometimes anti-fungal medications are prescribed during the Post-BMT Phase to treat these different types of infection.

To help identify an early infection, it is important to let the health care team know how you are feeling. Some symptoms of an infection are:

- Fever of greater or equal to 38°C (Celsius) or 100°F (Fahrenheit)
- Skin tenderness
- Chills/sweating
- A burning feeling when urinating
- Rectal pain/tenderness
- A cough, sore throat or mouth pain

If any of these symptoms appear, notify your nurse or doctor immediately.

**Managing Low Red Cell Counts**

**Symptoms & Management**

Red blood cells contain hemoglobin which carries oxygen from the lungs to all of the tissues in the body. This is what gives us our energy. After you receive your transplant, your red blood cell count will decrease quickly and will remain low until the new cells begin to grow.

When red blood cells are low, patients become anemic and may feel quite tired and short of breath as a result. Other symptoms may include dizziness and feeling chilled. Until the transplanted bone marrow starts making enough red blood cells on its own, you will require red blood cell transfusions to maintain your red blood cell count. Generally, when your hemoglobin count drops below 80, you will receive packed (concentrated) red blood cells. Some patients may require them sooner.

To read more about transfusions, go to page 24.

**Managing Low Platelet Counts**

**Overview**

Platelets (thrombocytes) are tiny blood cell particles that help form clots and prevent bleeding. They do so by sticking to the site of a blood vessel injury, clump together, and seal off the injured blood vessel to stop bleeding. When platelets are low, you are more susceptible to bleeding. Some signs and symptoms that may
Please notify your nurse or doctor of the following:

1. Bruising
2. Bleeding wounds
3. Blood in your urine or stool
4. Bleeding gums or nose
5. Blood in any mucous/sputum that is coughed up
6. Small pinpoint red or purple spots under your skin (petechiae)

Precautions Against Bleeding

While your platelets are low, there are some precautions you can take to prevent bleeding:

1. Take good care of your skin and lips, as dryness may lead to cracks and bleeding.
2. Use only a soft toothbrush. Do not scrub your gums vigorously.
3. Avoid blowing or picking your nose.
4. Use only an electric razor.
5. Wear shoes or slippers at all times when you are out of bed.
6. Exercise by walking or riding a stationary bike. Avoid rough activity or exercises that may cause you to injure your head or other parts of your body.

Symptoms & Management

If your platelet count drops below “10” or you have bleeding issues, you will need a transfusion. Your platelet count may be checked as often as every day and you will be watched for signs of bleeding. Please notify your nurse or doctor of the following:

1. Bruising
2. Bleeding wounds
3. Blood in your urine or stool
4. Bleeding gums or nose
5. Blood in any mucous/sputum that is coughed up
6. Small pinpoint red or purple spots under your skin (petechiae)

Until the transplanted stem cells start making enough platelets, you will require platelet transfusions. Platelet transfusions may also be necessary for a period of time after discharge from hospital.
Transfusions

Overview

You may require blood (red cells) and/or platelet transfusions frequently during your treatment. With all transfusions there is the potential of having a transfusion reaction. Because of this, the blood product is irradiated and leuko-reduced (white cell reduced) to decrease the likelihood of a transfusion reaction. If you have had a transfusion reaction in the past, please inform your nurse or doctor. If at any time during or after a transfusion you feel warm or chilled, have shortness of breath, are dizzy, notice hives (bumps/welts on your skin similar to giant mosquito bites) or if your skin itches, notify your nurse immediately.

Where does donated blood come from? Is it safe?

Whole blood is collected by Canadian Blood Services from volunteer donors. All potential donors are screened by a written questionnaire and interviewed by a nurse. The donated blood is processed into its separate parts and tested for:

1. Hepatitis B
2. Hepatitis C
3. Human Immunodeficiency Virus (HIV 1 and 2 – the AIDS viruses)
4. Human T-Cell Lymphotripic Virus 1 and 2
5. Syphilis
6. West Nile Virus (summer times)

If the blood is found to have any of these infections, it is disposed of and never used. Blood is never collected from this infected donor again. However, you need to be aware that blood can never be guaranteed to be 100% safe. Your doctor will discuss this further with you prior to your first transfusion. You will need to sign a blood product consent form before receiving any blood products.

To read more about the blood transfusion procedure, refer to Diagnostic Tests & Procedures in the Core Module.

Discharge

When are patients discharged?

Criteria for Discharge

Patients receiving a transplant can usually expect to be in hospital for at least three weeks. The health care team ensures that you are stable enough to permit monitoring as an outpatient before discharging you.
A few criteria that need to be met prior to discharge are:

- Blood cell counts (white cells, red cells and platelets) have reached a satisfactory level. You may still need blood product transfusions as an outpatient.
- There are no complications present that would stop you from being monitored as an outpatient.
- Your status is stable enough to permit monitoring on an outpatient basis.
- You are able to maintain adequate fluid intake and eat a satisfactory diet with sufficient calories to maintain weight.
- You have sufficient strength and mobility to attend regular clinic visits.
- You are able to take the required medications.
- You have a suitable place to live, preferably within 45 minutes of the hospital, while attending the Outpatient Daycare Unit.

**Preparations for Discharge**

Plan to stay in the Vancouver area for several weeks after you are discharged. There may be some exceptions to this rule; however, you should be aware of this and make the necessary arrangements without delay. This is necessary so your progress may be monitored closely in the Leukemia/BMT Daycare Outpatient Unit.

Before you are discharged, the clinical pharmacist will see you. They will thoroughly discuss your discharge medications with you before you leave. They will review with you the purpose of each medication as well as the dose, time, special instructions and major side effects and drug interactions. The pharmacist will provide you with a medication calendar to help you keep track. Keep it with you at all times.

If you are taking care of your own Hickman® line at home, the nurse will provide you with a supply kit unless the Hickman® line is to be removed shortly after your discharge.
Discharge Checklist

Before you are discharged from the Leukemia/BMT Inpatient Unit, please make sure that the items in the Discharge Checklist have been completed or discussed with the nurse or doctor.

**Medications**

- I have received my prescriptions.
- I know where to have each prescription filled.
- I know how and when to take my medications.
- I have an organizing system for my medications.
- I know what my medications are for and the major side effects and drug interactions.
- I know who to call if I have any questions.

**Monitoring for Complications**

- I have a Celsius thermometer to use at home after discharge.
- I know what signs and symptoms to report immediately.
- I know who to call to report signs and symptoms.
- I know who to call for assistance in an emergency.

**Follow-Up at Leukemia/BMT Daycare Unit**

- I know the date and time of my first CP6 Outpatient Daycare Unit appointment.
- I know where the BMT Daycare Unit is located.
- I have read the section on Outpatient Unit: Leukemia/BMT Daycare in the Core Module.
- If applicable, accommodation in the Lower Mainland has been arranged for my discharge.
BMT Day 100 (3-Month) Evaluation

Most BMT patients will have a series of tests done approximately 3 months after their transplant. The goal of this evaluation is to reassess the outcomes of the transplant. The workup has two purposes:

1. To determine the status of the underlying disease (the original diagnosis)
2. To assess any possible side effects of the treatment

The tests are necessary to rule out any possible complications. These tests can determine if there is a problem even though there may be no symptoms. You will be familiar with many of the tests.

There is often a one-year post-BMT evaluation for the same reasons listed above. Again, many of the tests will be familiar to you. Your BMT doctor or the nurses will give you more information about these evaluations as the day approaches.

Notes
Disclaimer:

Please note that the information contained in this manual is not intended to replace the advice of your health care team. Use this as a reference and education guide. Consult your health care team if you have any questions or concerns.