



## Haematology and transplant day unit

### Collecting bone marrow or peripheral blood stem cells

#### Introduction

This information is written to guide you through each stage of the stem cell or bone marrow collection process. If you have any further questions, please speak to the specialist nurses involved in the collection process (apheresis/ transplant co-ordinators).

#### What is a stem cell?

A stem cell is an immature parent cell which is able to grow and divide into red blood cells, white blood cells and platelets. The type of blood cell that a stem cell will develop into depends on the specific needs of the body at any one time. Stem cells originate in the bone marrow but it is possible to move them into the peripheral blood stream and collect them from there.

#### What is bone marrow?

Bone marrow is a spongy tissue found inside certain bones in the body mainly the sternum (breast bone), pelvis, humerus (upper arm), femur (thigh) and ribs, and it is where stem cells originally grow.

#### Why are my stem cells or bone marrow needed?

Bone marrow or peripheral blood stem transplants are used in the treatment of illnesses such as leukaemia, lymphoma, myeloma or aplastic anaemia. The aim of a transplant (high dose therapy) is to help get rid of any remaining disease with high doses of chemotherapy and occasionally radiotherapy.

Most cancer drugs and some radiotherapy treatments damage normal tissue as well as cancer cells. The cells most affected are those lining the gut, the skin, hair follicles and the bone marrow stem cells. These can recover completely, given time.

Bone marrow stem cells are particularly vulnerable to intensive chemotherapy and radiotherapy. Healthy bone marrow stem cells can be collected before high dose chemotherapy/radiotherapy and then returned to you after the completion of intensive treatment to help 'rescue' your body from the damaging side effects of chemotherapy. These cells are able to travel into the bone marrow spaces and grow into healthy functioning cells.

#### How are stem cells collected?

- from the bloodstream (peripheral blood stem cell collection/apheresis)
- directly from the bone marrow (bone marrow harvest) – rare.

## **How are stem cells encouraged into the blood stream?**

The collection of stem cells from the peripheral blood is the most commonly used method of collection.

At any one point there are only a limited number of stem cells in the peripheral blood. In order to collect them from your blood we need to increase the number available and move them out of your bone marrow into your bloodstream where they can be collected or harvested. We generally do this using a combination of chemotherapy and growth factors (GCSF). Occasionally we may just use growth factors alone but this is rare. This process is called mobilisation.

In general, we are able to collect stem cells from you on our first attempt, however, some patients may need to undergo a second mobilisation attempt if an insufficient number of cells are obtained the first time around. Some patients may also need to have a drug called Plerixafor in combination with GCSF to help them mobilise stem cells adequately. Plerixafor enhances the effect of GCSF and increases the number of stem cells in the bloodstream by helping to release them from the bone marrow. It is given as a small injection under the skin by nursing staff on the haematology day unit.

## **Virology testing**

Before bone marrow or stem cell collection, your blood will need to be tested for certain blood-bound viruses. These include Hepatitis B, Hepatitis C, Human Immunodeficiency Virus (HIV), HTLV 1 & 2 (Human T-cells Lymphotropic Virus), Syphilis and Cytomegalovirus (CMV). These tests are a legislative requirement when storing and processing any human tissue and are governed by The Human Tissue Authority.

## **Samples for research and cell storage**

Occasionally stored cells are not used for treatment. They may be used in research or be discarded. Before your cells are collected we will ask you to sign a consent form. Please feel to ask your consultant or a member of the team any questions about this.

## **What does the chemotherapy do?**

Chemotherapy 'encourages' stem cells to come out of your bone marrow and into your peripheral blood stream. Many different types of chemotherapy regimens are used for this purpose. Most commonly, we use cyclophosphamide or we can use the course of chemotherapy you are currently having as part of your normal treatment, such as R-CHOP, DHAP, GDCVP, ICE, VIDE or ESHAP.

## **What is GCSF?**

GCSF (Granulocyte Colony Stimulating Factor) occurs in the body naturally and controls bone marrow reproduction. When given artificially it encourages stem cells to move from the bone marrow into the peripheral blood stream where they can be collected. GCSF is given daily as one or two small injections under the skin before a stem cell harvest. We can teach you or a relative to give these injections. Alternatively, we can arrange for a district nurse to give them to you. **Do not stop having these injections.**

The injections of GCSF may cause some bone pain and flu-like symptoms. Taking a simple painkiller such as paracetamol may help.

### **When will the cells be collected?**

The nurses on the stem cell/transplant team will arrange to regularly monitor your full blood count (FBC). They also take a special blood test, called a predictive count, to monitor the number of stem cells which have moved out into your bloodstream. When these tests indicate that there are enough stem cells in your peripheral blood stream you will have your stem cells collected.

These blood tests will generally be taken a set number of days after your chemotherapy has been completed and when you have had a set number of injections.

You will need to attend the haematology and oncology outpatients at 8:00am on the morning of these blood tests, as the predictive test takes a few hours to perform. These tests may need to be done for several days before your stem cell levels are adequate for collection to take place.

### **How are stem cells collected (harvested)?**

- Stem cells are collected using a machine called a cell separator.
- Blood flows out of a needle inserted into the crook of your arm into the machine via plastic tubing connected to the machine. This blood is then spun through a centrifuge at high speed. At intervals during the procedure, stem cells are removed and collected into an attached bag. The remaining blood is returned to you through a cannula in your hand. If you have poor veins, you may need a temporary plastic needle (femoral line) inserting into the groin at the top of the leg. However, we will make a full assessment of your veins before the procedure and discuss any problems with you if necessary.
- You can eat and drink normally before and during the procedure. Once you are attached to the machine, you cannot be disconnected until the procedure is completed. This takes about four to five hours.
- Your blood pressure and pulse will be monitored at the beginning and end of the procedure. If you feel dizzy or light-headed during the procedure it is important to let the nurse know. The machine is removing and returning blood to you continuously and even though there will be a very small amount of blood in the machine at any one time, it may be enough to make you light-headed.
- The machine uses an anticoagulant to prevent the blood from clotting. This may cause tingling around the lips, cheeks or fingertips as it can cause the calcium levels in your blood to drop. Let the nurse know if this happens. Oral tablets or an infusion into the cannula will prevent any complications.
- The collection is usually completed in one or two days. You may go home after the first day and we will advise you if you need to return the next day. If so, you will need more G-CSF injections that evening.
- You may feel tired after the procedure and we advise you to drink plenty of fluids and rest.
- There will be a nurse in attendance throughout the procedure.

## **What is a bone marrow collection (harvest)?**

**You are only likely to require this procedure if there are medical indications which would prevent you from having a stem cell harvest or in the very rare instance where we are unable to collect sufficient peripheral stem cells from your bloodstream.**

- This type of collection is carried out under a general anaesthetic and in theatres. You will be admitted into hospital the day before the harvest and you will need to have some blood tests and have an examination by a doctor. The doctor will discuss the procedure with you again and ask you to sign a consent form agreeing to the procedure.
- You are not allowed to eat or drink anything from midnight the night before the harvest. On the day we will ask you to shower and put on a hospital gown. Remove all your jewellery (except a wedding ring). When the theatre staff are ready for you, a porter and nurse will take you to theatre.
- The anaesthetist will insert a cannula (a plastic needle) into the back of your hand so you can have medication to put you to sleep.
- The doctor or nurse will collect the bone marrow from the back of your hip bones. He or she will put a needle into the bone and remove the bone marrow with a syringe and transfer this to a blood bag. The collection takes about an hour to complete and will remove about 1 to 1.5 litres of bone marrow. Your body can replace this in less than three weeks.
- A dressing is put over the puncture site to stop the site from bleeding and the staff will take you to the recovery room to 'wake up'.
- When you wake up you may have some fluids running into the cannula in your hand. This is to replace some of the fluid that has been taken during theatre. When you are properly awake we will take you back to the ward. You may also need a blood transfusion at this point.
- The staff on the ward will monitor you regularly and check the puncture sites, your blood pressure, temperature and pulse. They will also monitor your oxygen levels. You will then be able to drink and have some painkillers for the soreness in your back, hips and throat.
- Normally you will be discharged home the next day. We advise you to rest for the next few days and return to work the following week. We will give you some painkillers.

## Side effects of each procedure

G-CSF / Stem cell harvest	Bone Marrow Harvest
<ul style="list-style-type: none"> <li>• Injection site reactions</li> <li>• Bone pain</li> <li>• Flu like syndrome</li> <li>• Venous thrombo-embolism (rare)</li> <li>• Splenic rupture (very rare)</li> <li>• Poor mobilisation – may require repeat harvest (5-10%) or bone marrow harvest (uncommon)</li> <li>• Insertion of temporary central venous catheter (femoral line) if peripheral venous access is inadequate</li> <li>• This may be a problem if you are using Neupogen: Exceptionally rare but serious – capillary leak syndrome, symptoms include generalised swelling, puffiness, less frequent urination, difficulty breathing, abdominal swelling and extreme tiredness.</li> <li>• There are also theoretical concerns regarding the risk of developing leukaemia, although the available evidence indicates that donors treated with G-CSF are <b>not</b> at increased risk.</li> </ul>	<ul style="list-style-type: none"> <li>• General anaesthetic</li> <li>• Back pain</li> <li>• Anaemia – may require blood transfusion or iron supplementation</li> <li>• Infection at harvest site</li> <li>• Inadequate harvest that may require peripheral blood stem cell harvest.</li> </ul>

### What happens to the cells after they have been collected?

With both types of collection procedures the stem cells are taken to the laboratory and counted to calculate exactly how many have been collected. We also test to ensure there are no infections in the stem cells. Stem cells can safely survive for many years when frozen so they are stored in liquid nitrogen until needed.

Your consultant may decide to discard any stored cells:

- if not enough cells have been collected
- if the cells are no longer needed
- if the cells are infected

With your consent, any cells not used for your treatment may be used for research rather than discarded.

### What happens next?

When we have collected sufficient stem cells, we will arrange an outpatient appointment for you to see your consultant. He or she will discuss your next treatment option. If you are going straight to transplant, we will give you a date for admission at this meeting. This is a good time for you to bring a list of questions with you.

## **Cyclophosphamide chemotherapy- what is involved?**

- **Monday or Tuesday, Day 1:** In general, you will receive this chemotherapy as an outpatient.
- Before the treatment starts we will give you some intravenous anti-sickness drugs through your central line or through a peripheral cannula.
- The chemotherapy can irritate your bladder and in worse cases cause cystitis. To prevent this, we will give you drug called mesna through your cannula before your chemotherapy. After your chemotherapy, we will give you a tablet form of mesna to take.
- Cyclophosphamide is a colourless fluid given either through your central line or through a peripheral cannula over 2 hours.
- **Day 2:** You will start the growth factor injections the following day. We recommend that these are given last thing at night. We can arrange for a district nurse to give you these, or teach you or a family member to give them.

## **What complications should you look out for?**

- We advise you to drink 2 to 3 litres of fluid for the next few days to help flush your kidneys and bladder. Once at home, if you experience any pain or problems when passing water or any blood in your urine, please contact The Christie Hotline.
- You may experience some nausea and even sickness. We will give you anti-sickness tablets to take home with you.
- You may also have diarrhoea.
- The chemotherapy will suppress your blood counts for a short time and make you more vulnerable to infections. We will give you some extra antibiotics to take. Keep a check on your temperature while you are at home.

**Contact The Christie Hotline immediately on 0161 446 3658 if you have any problems, or are feeling unwell.**

**GCSF:** The day after this chemotherapy, you will need to start having daily injections of growth factor (GCSF). These are small injections given just under the surface of the skin. We can teach you to give yourself injections or we will arrange for a district nurse to give them to you.

**Do not stop the injections.**

They may cause a throbbing bone pain (as your bone marrow is being stimulated to produce stem cells) and/or make you have flu-like symptoms. Taking simple painkillers such as paracetamol is helpful.

## **At home with G-CSF: A patient's guide to self-injection with G-CSF**

There are two types of G-CSF. One can be stored at room temperature and needs preparation before being given (Granocyte). The other is stored in the fridge and is already pre-prepared (Neupogen). They both work equally well. This is a guide of how to administer both types of G-CSF.

Both types of injection are best given last thing at night. You may need one or two injections depending on your body weight.

### **GRANOCYTE**

1. Remove the syringe, the needles and the vial from the pack and lay them out on your chosen clean work surface.
2. Unpack both needles by peeling apart their plastic packaging and removing them, still in their sheaths. When doing this, do not touch the open ends of the needle hubs. Lay the needles on your work surface.
3. Remove the grey cap from the syringe and fit the white needle to the syringe in its place. Do not remove the sheath at this stage.
4. Next remove the plastic top from the vial, exposing the rubber stopper.
5. Remove the sheath from the white needle and holding the vial steady on a flat surface, push the needle through the centre of the rubber stopper. Inject the contents of the syringe (water for injections) slowly into the vial. Do not worry about any air bubbles that you see in the water.
6. Without removing the needle from the vial, hold the syringe and vial horizontally and gently rotate the vial to dissolve all of the powder. This should take about 5 seconds.
7. Now turn the vial upside down and, making sure that the needle tip stays under the surface of the liquid throughout the operation, slowly draw all the liquid from the vial.
8. Withdraw the needle from the vial.
9. Holding the syringe needle uppermost, see if there are any air bubbles in the syringe. If there are, tap the syringe with one finger to send the air bubbles to the top. Then expel them gently using the plunger of the syringe.
10. Carefully detach the white needle from the syringe and fit the brown needle in its place, without removing the brown needle sheath.
11. Put the white needle and the used vial in the sharp's bin. The granocyte injection is now ready.
12. If you have been prescribed two doses of G-CSF then these can be given as one injection. Carry out the procedure to point 8, and then, repeat points 6-8, and complete as above.

## At home with G-CSF: A patient's guide to self-injection with G-CSF

### NEUPOGEN/ZARZIO

1. Remove the injection from the fridge and allow it to warm to room temperature. The injection is now ready

### GIVING YOURSELF THE INJECTION

1. For self-injection, the most convenient injection sites are the front or outer sides of the thighs and the front of your abdomen (tummy). To avoid the risk of soreness at the injection site, inject into a different place and alternate which side you inject each day.
2. Pick up the loaded syringe and remove the needle sheath.
3. Holding the syringe like a pen in one hand, use your other hand to pinch up a fold of skin at the chosen injection site.
4. Now push the needle quickly into the fold of skin at an angle of about 45 degrees.
5. Then slowly push the plunger of the syringe until the syringe contents have all been injected under the skin.
6. Now pull the needle out, keeping it at the same angle as when it went in. If there is any leakage from the puncture site, press it lightly for a few seconds with a clean tissue or piece of cotton wool.
7. Drop the needle into the sharp's bin. Please note that Zarzio has a spring loaded mechanism which will retract the needle as it is withdrawn from the skin.

### Further information

#### Useful booklets

Donating bone marrow or peripheral blood stem cells  
Donating stem cells, what's involved?  
Autologous stem cell transplant  
High dose therapy and autologous stem cell transplant  
Bone marrow and stem cell transplantation  
Mozobil (plerixafor) – your questions answered

Chugai Pharma UK Ltd  
Bloodwise  
Lymphoma Association  
Myeloma UK  
Bloodwise  
Genzyme

#### Useful Websites

**NHSBT.nhs.uk**  
**Cancerresearch.uk.org**  
**Macmillan.org.uk**

#### Contact numbers

Apheresis/transplant nurse co-ordinators

Out of hours

Tel: **0161 446 8011** or **0161 918 7219**  
or **0161 446 3000** bleep (via switch) **12735**  
The Christie Hotline: **0161 446 3658**

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Contact The Christie Hotline for urgent support and specialist advice

**The Christie Hotline:  
0161 446 3658**

Open 24 hours a day, 7 days a week

We try to ensure that all our information given to patients is accurate, balanced and based on the most up-to-date scientific evidence. If you would like to have details about the sources used please contact **patient.information@christie.nhs.uk**

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