Introduction
This factsheet is written to help explain what is involved when you undergo a peripheral blood stem cell (PBSC) harvest. It explains what haematopoietic stem cells are; why we need to collect them; what happens before, during and after the harvest, and what happens when you have your stem cells back. Specific details of your planned PBSC harvest will be given to you by your Stem Cell Harvesting Team.

Haematopoietic stem cells
Haematopoietic stem cells are the source of all blood cells. Normally before they go into your bloodstream your body signals them to become the different blood cells (red cells, white cells or platelets).

Stem cells are normally only found in large numbers in the bone marrow inside your bones. To make the stem cells move (mobilise) from the bone marrow into your bloodstream your body needs to produce more of these cells than is normal, so we help it by using a special growth factor called granulocyte-colony stimulating factor (GCSF). This enables the stem cells to produce more than you need and they move from your bone marrow into your bloodstream.

Normally this is done following a course of your chemotherapy protocol. However, for some protocols this is done without chemotherapy and this is called a steady state mobilisation.

Why do we need to collect stem cells?
Your Consultant will have discussed your treatment protocol with you. We have learnt that in order to have the best chance of getting rid of your cancer and giving you the best chance of a cure, we need to use very high doses of chemotherapy. But we also know that this is a very difficult treatment and, if we only used the high dose chemotherapy, your body may not be able to grow its own blood cells again, and that you would be at risk of infections with low platelets and red blood cells for a very long time. By having your own stem cells back (known as an autologous stem cell infusion), your body is able to start to grow its own replacement red cells, platelets and white cells. This happens around two to four weeks after the stem cells have been given back.

Collection of your stem cells will be done in advance and then stored for future use, if that is what is needed. Your protocol will state the likely time for your PBSC to be collected.

The PBSC team are trained in the collection of PBSC and will be responsible for you during this procedure. Each treatment centre will differ slightly with where PBSC harvesting occurs. You may have your stem cells collected at your treatment centre or you may have to travel to a different hospital or even to a blood transfusion centre for this procedure.

What happens before the harvest?

Pre-harvest investigations

Blood tests - It is a legal requirement within the UK that the results of specific blood tests are known before any stem cell harvest. These blood tests look for certain viruses, for example, Hepatitis B, Hepatitis C and HIV. The PBSC team will discuss all of these tests with you. They need to be done within 30 days of the collection day and the results are sent to the Stem Cell Laboratory before the cells are collected.

Consent
The Department of Health Human Tissue Authority (HTA) has strict guidelines that we must follow. Before we take your
cells we must get written consent for the testing, storage and discard of these cells. The PBSC team will go through the form with you and your parents. If you have any questions please feel free to ask.

**Mobilisation of stem cells**

Before we can collect the stem cells, you will require daily injections of GCSF to increase the number of stem cells your body produces and to allow them to move from your bone marrow into your circulating blood. GCSF is a hormone naturally produced by the body. It has two major functions: to create replacement stem cells in the bone marrow, and to turn stem cells in the bone marrow into mature blood cells.

Usually between 7-16 days of starting GCSF, following your chemotherapy, or 5 days if you haven’t had chemotherapy, your white count will rise and your stem cells will mobilise from the bone marrow into the peripheral blood.

As with all drugs there are possible side effects of GCSF. The most common are listed below:

- Injection site reactions
- Headache
- Tummy upsets such as nausea, vomiting and diarrhoea
- Rash
- Achy flu-like symptoms
- Temperature

Many of these symptoms are common following chemotherapy and if they do occur you may need to be admitted to hospital for treatment as it may indicate an infection. If you are concerned please contact your hospital immediately.

The GCSF is given as a subcutaneous (below the skin) injection in the arm, leg or abdomen. The injections are best given at the same time each day.

The first injection will be given in hospital. Some treatment centres will then teach you or your parents to do these injections at home. Nursing staff will show you how to do this. If you are unable to do this at home you may be able to have a local community nurse or hospital do this for you.

You may be offered a very small subcutaneous cannula, called an insufion. The insufion enables the needle to be inserted into the end of the insufion instead of the skin. Some people choose to just have a subcutaneous injection and no insufion. The nursing staff will explain both methods so you can choose which is right for you.

Regular blood tests will be taken throughout the mobilisation. By looking at the results of these closely we can determine the best day for your harvest. This will usually be when the white blood cells increase rapidly.

**Red blood cells (haemoglobin)** - Your red blood cell count will be kept over 10 prior to the harvest. This may mean that you need to have a blood transfusion during your mobilisation.

**Platelets** - During the blood tests some of your platelets will be collected into the collection bag. Your platelets will be checked so that a minimum can be maintained.

**Apheresis/central line** - In the days leading up to the harvest when the blood samples are being taken we will also check that your apheresis/central line is sampling and flushing easily. This helps us to ensure that we can get a good flow rate during the PBSC harvest.

If the apheresis/central line is not sampling or flushing easily you may have a drug called Urokinase put into the line for several hours to dissolve any blockage. The staff will discuss this with you should it need to happen.

When your white cells reach a certain level the laboratory will be able to perform a specific test called a CD34 level which will tell us how well your stem cells have mobilised. This test will tell us when it is the right time to harvest the stem cells.

**Beginning the PBSC harvest**

At the start of your treatment, when we know that you are likely to need PBSC harvesting, you may have had a double lumen apheresis line put in to prepare for your harvest. However if you don’t have a line like this you can also have this procedure using a permanent hickman line and a canulae, have a temporary apheresis line put in or even two canulae. Your PBSC team will discuss the best options for you.

Two lines are needed so that a constant flow of blood is taken from your blood stream, passed through a machine called a “cell separator” and constantly returned back into your blood stream through the other line once the cells have been collected. A sterile single use kit will be fitted into the cell separator. You will be connected to the lines from the single use kit. One line will take blood from you and the other will return your blood. Staff trained to do this procedure will stay with you throughout. The separator will be filled with fluid and the staff will enter information about you such as height, weight, sex, and information from your blood count taken earlier that day. Once this information has been put into the machine, the PBSC harvest can start. The amount of blood in the machine at any one time is around 200mls (about the equivalent of a mug full).

To stop the blood from clotting in the machine a drug called ACDA (acid-citrate Dextrose solution) is given. A small amount is added constantly and this happens in the cell separator. The nurse operating the machine will show you where this happens if you want.

The most common side effect during this procedure is caused by the ACDA. The ACDA works by attaching itself to the calcium in your blood to stop your blood
clotting in the tubing. This goes back to normal when the machine is finished and the ACDA stops. However, you may develop side effects during the PBSC harvest due to having low calcium levels in your blood.

Side effects in children and young people are rare but may include:
- Pins and needles in the fingertips/feet or lips
- Cramping in the face or hands
- Just not feeling well.

During the procedure your nurse will ask you to drink milk or have yoghurt, ice cream or eat some cheese. These all have calcium in them and help to prevent possible side effects. Sometimes we may ask you to chew a calcium tablet or have a drink with calcium dissolved in it.

The machine needs the blood to flow freely from your line and also back in to you through the other line. Sometimes your lines can be very sensitive and the machine may have a pressure alarm if the blood is not able to flow freely. You may need to have your lines flushed during the procedure and you may also need to move your position to get a better blood flow to and from the machine.

What can you do during the PBSC harvest?
The harvest can last between 4-5 hours. You will have to remain on the bed/chair during the harvest. You can read, do school work, watch TV or play video games as normal. You might like to have a picnic with your family as this will help to pass the time. If you need the toilet you can use a commode.

What happens when the PBSC harvest has completed?
When the harvest has completed, you will be taken off the machine and some blood samples will be taken. You can then go home. The stem cells will be taken down to the Stem Cell Laboratory.

The scientists in the laboratory take a small sample of the stem cells so that they can test it to tell us how many cells have been collected. Depending on when the PBSC harvest finished this may happen on the same day or early the next morning. If enough stem cells have been collected we will not have to do a second day of PBSC harvesting. However if we have not collected enough cells, you will need to continue on GCSF and we will need to do a second day of PBSC harvesting.

What happens to the stem cells?
The staff in the Stem Cell Laboratory will store the peripheral blood stem cells by freezing them in a special way called cryopreservation. The cells are mixed with a preservative (DMSO) to protect them while they are frozen. They will be stored until you need them as part of your treatment. The storage of the cells will be discussed with you when you sign the consent for collections forms.

If you have any questions please ask the PBSC harvesting team.

Autologous (from yourself) stem cell transplant - What happens when you have your stem cells back?
Depending on your diagnosis and treatment the time that you have your stem cells back will vary. Sometimes the stem cells are collected in advance and the decision on whether you need to have this treatment is made later.

If you are going to have a stem cell transplant your team will discuss with you when this will happen and what chemotherapy/treatment you will be having. You will get a copy of your transplant/treatment protocol and the chemotherapy/drug treatment that you will need.

The possible side effects of having high dose chemotherapy will differ depending on the chemotherapy/drug treatment. Your team will discuss with you the side effects of your individual treatment plan.

Your stem cells will be given back after you have completed your chemotherapy/treatment. This usually happens within a week of your chemotherapy/treatment finishing.

The Stem Cell Nurses will arrange for your stem cells to be given back. This involves a lot of organisation with the Stem Cell Laboratory to make sure that your cells are taken out of the freezer and only used for you.

The cells are defrosted and given back quickly. They are given back as an intravenous infusion and this is normally done using your central line. Depending on how many cells were collected and how they have been stored in the laboratory you may have more than one bag of stem cells. These may need to be given back over one or several days.

Side effects
We know that there can be some potential side effects when you have your stem cells back. This can be caused by the natural defrosting process or the preservative (DMSO) added to the cells to protect them as they are frozen.

Unpleasant taste - metal or garlic
When your stem cells first go into your body you can get an unpleasant taste in your mouth. This does not last long. Sucking a strong sweet, such as a mint, can help reduce this.

Smell of sweet corn
You don’t actually realise that this is happening, but your family, visitors and the staff will be able to smell sweet corn. This happens because your body is getting rid of the preservative through your skin. It smells
very strong on your breath and when you go to the toilet. This side effect usually only lasts a day or two.

**Being and feeling sick (vomiting and nausea)**
Anti-sickness drugs will continue to be given regularly.

**Red urine (Haemoglobinuria)**
Sometimes when your stem cells are collected some of your red cells are also collected, (if you have had your bone marrow collected then there will be a lot of red cells in these stem cells). Red cells do not survive when they are frozen and then defrosted.

Red cells that your body have finished with are normally passed out of your body in your urine and you don’t see them. If you have a lot of red cells in your stem cells you will wee them out and your urine can look very red. If this is happening we will give you some fluid to flush and protect your kidneys so that these extra cells don’t cause you any problems.

**Severe reactions (Anaphylaxis)**
You are not reacting to the stem cells as they are your own cells but to the preservative used to protect the cells. To reduce this risk you will be given anti-reaction drugs (pre-medication) before you have your stem cells back. When you are having your stem cells back, and for a period of time afterwards, you will be monitored closely by the nurses caring for you.

After your stem cells have been infused you may need to stay in hospital until your team are happy that you are well enough to go home. This time can vary greatly depending on what sort of chemotherapy/treatment you have had. Discuss this with your team and remember that you can always ask questions if you have any concerns.

Once your stem cells have been given back they are extremely clever and they will find their way back into your bone marrow factory. You may need to have GCSF to help your cells to recover. The cells start working by continuing to grow all of your body’s red cells, white cells and platelets. It can take up to two to three weeks for this to happen.

We hope this information has helped you to understand this part of your treatment. If you have any questions ask your team.

The CCLG supports the 1,700 children who develop cancer each year in Britain and Ireland. As an association for healthcare professionals involved in their care, it works to benefit children through development of the highest standards of care. CCLG is a major provider of accredited information for patients and families.

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