

Leukaemia

Leukaemia is a cancer of blood-forming cells. There are different types. If you develop leukaemia it is important to know what type it is. This is because the outlook (prognosis) and treatments vary for the different types. This leaflet gives a general overview. Separate leaflets give more details about the different types of leukaemia.

What is leukaemia?

Leukaemia is a cancer of cells in the bone marrow (the cells which develop into blood cells).

Cancer is a disease of the cells in the body. There are many types of cancer which arise from different types of cell. What all cancers have in common is that the cancer cells are abnormal and do not respond to normal control mechanisms. Large numbers of cancer cells build up because they multiply 'out of control', or because they live much longer than normal cells, or both.

With leukaemia, the cancerous cells in the bone marrow spill out into the bloodstream. There are several types of leukaemia. Most types arise from cells which normally develop into white blood cells. (The word leukaemia comes from a greek word which means 'white blood'.) If you develop leukaemia it is important to know exactly what type it is. This is because the outlook (prognosis) and treatments vary for the different types. Before discussing the different types of leukaemia it may help to know some basics about normal blood cells and how they are made.

What is normal blood made up of?

- **Blood cells**, which can be seen under a microscope, make up about 40% of the blood's volume. Blood cells are divided into three main types:
 - **Red cells** (erythrocytes). These make blood a red colour. One drop of blood contains about five million red cells. Red cells contain a chemical called haemoglobin. This binds to oxygen, and takes oxygen from the lungs to all parts of the body.
 - **White cells** (leukocytes). There are different types of white cells which are called neutrophils (polymorphs), lymphocytes, eosinophils, monocytes, and basophils. They are part of the immune system. Their main role is to defend the body against infection.
 - **Platelets**. These are tiny and help the blood to clot if we cut ourselves.
- **Plasma** is the liquid part of blood and makes up about 60% of the blood's volume. Plasma is mainly made from water, but contains many different proteins and other chemicals such as hormones, antibodies, enzymes, glucose, fat particles, salts, etc.

When blood spills from your body (or a blood sample is taken into a plain glass tube) the cells and certain plasma proteins clump together to form a clot. The remaining clear fluid is called serum.

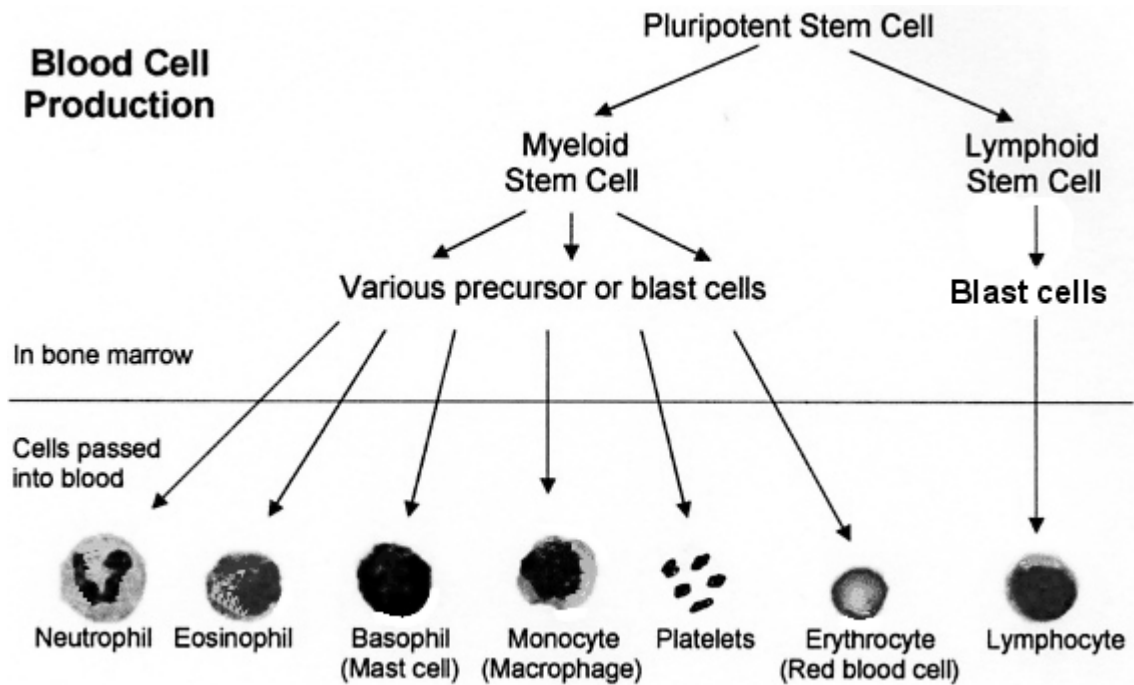
The bone marrow, stem cells and blood cell production

Bone marrow

Blood cells are made in the bone marrow by 'stem' cells. The bone marrow is the soft 'spongy' material in the centre of bones. The large flat bones such as the pelvis and breast-bone (sternum) contain the most bone marrow. To constantly make blood cells you need a healthy bone marrow. You also need nutrients from your diet including iron and certain vitamins.

Stem cells

Stem cells are primitive (immature) cells. There are two main types in the bone marrow - myeloid and lymphoid stem cells. These derive from even more primitive common 'pluripotent' stem cells. Stem cells constantly divide and produce new cells. Some new cells remain as stem cells and others go through a series of maturing stages ('precursor' or 'blast' cells) before forming into mature blood cells. Mature blood cells are released from the bone marrow into the bloodstream.



- Lymphocyte white blood cells develop from lymphoid stem cells. There are three types of mature lymphocytes:
 - B lymphocytes make antibodies which attack infecting bacteria, viruses, etc.
 - T lymphocytes help the B lymphocytes to make antibodies.
 - Natural killer cells which also help to protect against infection.
- All the other different blood cells (red blood cells, platelets, neutrophils, basophils, eosinophils and monocytes) develop from myeloid stem cells.

Blood production

You make millions of blood cells every day. Each type of cell has an expected life-span. For example, red blood cells normally last about 120 days. Some white blood cells last just hours or days - some last longer. Every day millions of blood cells die and are broken down at the end of their life-span. There is normally a fine balance between the number of blood cells that you make, and the number that die and are broken down. Various factors help to maintain this balance. For example, certain hormones in the bloodstream and chemicals in the bone marrow called 'growth factors' help to regulate the number of blood cells that are made.

The main types of leukaemia are:

- acute lymphoblastic leukaemia - 'ALL' (sometimes called acute lymphocytic leukemia).
- acute myeloid leukaemia - 'AML'.
- chronic lymphocytic leukaemia - 'CLL'.
- chronic myeloid leukaemia - 'CML'.

There are various 'subtypes' of each of these. In addition there are some other rare types of leukaemia. The word:

- 'acute' means the disease develops and progresses quite quickly.
- 'chronic' means persistent or ongoing. When talking about leukaemia the word chronic also means that the disease develops and progresses slowly (even without treatment).
- 'lymphoblastic' and 'lymphocytic' mean that an abnormal cancerous cell is a cell that originated from a lymphoid stem cell.
- 'myeloid' means that an abnormal cancerous cell is a cell that originated from a myeloid stem cell.

There are separate leaflets that give details about each of these types of leukaemia. Briefly:

Acute lymphoblastic leukaemia (ALL)

In ALL the bone marrow makes large numbers of abnormal immature lymphocytes called lymphoblasts. There are various sub-types of ALL. For example, the abnormal lymphoblasts can be immature B or T lymphocytes. Typically, ALL develops quite quickly (acutely) and rapidly becomes worse (over a few weeks or so) unless treated. ALL can occur at any age, but about 6 in 10 cases occur in children. It is the most common form of leukaemia to affect children (although it is an uncommon disease).

Acute myeloid leukaemia (AML)

In AML the bone marrow makes large numbers of abnormal immature white blood cells which are derived from a myeloid stem cell. The abnormal immature cells are called blasts. There are various sub-types of AML, depending on exactly what cell type becomes cancerous and at what stage in the maturing process. Typically, AML develops quite quickly (acutely) and rapidly becomes worse (over a few weeks or so) unless treated. AML is an uncommon disease. Most cases occur in people aged over 40.

Chronic lymphocytic leukaemia (CLL)

In CLL you have many abnormal B-lymphocytes. The main reason for the build-up of the abnormal lymphocytes is because they live too long - they do not die after the usual lifespan of a lymphocyte. (This is different to the acute types of leukaemia where the cells rapidly multiply 'out of control'. In CLL the abnormal lymphocytes are not thought to multiply faster than normal lymphocytes.) Typically, CLL develops and progresses very slowly - over months or years, even without treatment. CLL is the most common type of leukaemia. It occurs in about 3 in 100,000 people each year. Most cases occur in people over the age of 60.

Chronic myeloid leukaemia (CML)

CML develops due to a problem with a stem cell in the bone marrow which becomes abnormal. The abnormal stem cell multiplies and the cells that are made from the abnormal stem cells mature and develop into near normal white cells - mainly neutrophils, basophils and eosinophils (collectively called granulocytes). Typically, CML develops and progresses slowly - over months or years, even without treatment. CML is the rarest of the four main types of leukaemia. There are less than 1000 cases in the UK each year. It occurs mainly in adults, and becomes more common with increasing age.

What causes leukaemia?

A leukaemia is thought to first start from one abnormal cell. What seems to happen is that certain vital genes which control how cells divide, multiply, and die are damaged or altered. This makes the cell abnormal. If the abnormal cell survives it may multiply 'out of control' or survive a long time, and develop into a leukaemia.

In most cases of leukaemia, the reason why a cell becomes abnormal is not known. There are certain 'risk factors' which increase the chance that certain leukaemias will develop, but these only account for a small number of cases. Risk factors for some types of leukaemia include:

- Radiation. For example, previous radiotherapy for another condition. Many of the survivors of the atom bomb used in world war II developed leukaemia due to the fall out of radiation.
- Past treatment with chemotherapy or other drugs that weaken the immune system.
- Certain genetic disorders, the most common being Down's syndrome.
- Exposure to certain chemicals such as benzene.

What are the main symptoms of leukaemia?

As large numbers of abnormal blood cells are made, much of the bone marrow fills with these abnormal cells. Because of this it is difficult for normal cells in the bone marrow to survive and make enough normal mature blood cells. Also, the abnormal cells spill out into the bloodstream. Therefore, the main problems which can develop include:

- Anaemia. This occurs as the number of red blood cells in the bloodstream goes down. This can cause tiredness, breathlessness and other symptoms. You also look pale.
- Blood clotting problems. This is due to low levels of platelets in the bloodstream. This can cause easy bruising, bleeding from the gums, and other bleeding-related problems.
- Serious infections. The abnormal white blood cells do not protect against infection. Also, there is a reduced number of normal white blood cells which usually combat infection. Therefore, serious infections are more likely to develop. Depending on the type and site of infection which develops, the symptoms can vary greatly.

The time taken to develop these symptoms after the disease starts varies. Typically, it is within weeks for ALL or AML. It may take months or years for symptoms to develop with CLL or CML as these leukaemias progress slowly.

The abnormal cells may also build-up in lymph glands and in the spleen. You may therefore develop swollen glands in various parts of the body, and develop an enlarged spleen.

Other symptoms which may develop include: pain in the bones or joints (mainly with ALL), persistent fever, and weight loss.

How is leukaemia diagnosed and assessed?

A blood test

A blood test can often suggest the diagnosis of leukaemia as abnormal cells are often detected in the blood test. Further tests are usually done to confirm the diagnosis.

A bone marrow sample

For this test a small amount of bone marrow is removed by inserting a needle into the pelvis bone (or sometimes the breastbone (sternum)). Local anaesthetic is used to numb the area. A small sample of bone may also be taken. The samples are put under the microscope to look for abnormal cells, and tested in other ways. This can confirm the diagnosis. (A separate leaflet describes bone marrow biopsy in more detail.) A bone marrow test may not be needed to confirm the diagnosis of CLL.

Cell and chromosome analysis

Detailed tests are often done on abnormal cells obtained from the bone marrow sample or blood test. These find out the exact type, or sub-type, of the cell that is abnormal.

Lumbar puncture

This test collects a small amount of fluid from around the spinal cord (cerebrospinal fluid - CSF). It is done by inserting a needle between the vertebra in the lower (lumbar) region of the back. A separate leaflet describes this test in more detail. By examining the fluid for leukaemia cells, it helps to find out if the leukaemia has spread to the brain and spinal cord. This is mainly done when assessing ALL, and sometimes AML.

Various other tests

A chest x-ray, blood tests, and other tests are done to assess your general wellbeing.

What is the treatment for leukaemia?

The treatment advised depends on the exact type of leukaemia, and the stage it is at. For example, ALL is usually treated as soon as possible with intensive chemotherapy. On the other hand, people in the early stages of CLL may not need any treatment. This is because CLL often progresses very slowly and may not need treatment for several years.

See the separate leaflets for details of treatments for each type of leukaemia. Your specialist will advise on the treatment needed for your particular condition.

What is the outlook (prognosis)?

The outlook varies for each of the different leukaemias. However, the overall outlook may be better than many people imagine. For example, the outlook for ALL has greatly improved over the last 20 years or so. Most children with ALL (about 7-8 in 10 cases) can be cured. Also, the chronic leukaemias (CLL and CML) often progress slowly - often over several years. Even in those cases which are not cured, treatment with chemotherapy and other treatments can often prolong survival for quite some time.

Your specialist will advise on the outlook for your particular condition.

Further help and information

CancerBACUP

3 Bath Place, Rivington Street, London, EC2A 3JR

Tel: 0808 800 1234 Web: www.cancerbacup.org.uk

Provides information and support to anyone affected by cancer or leukaemia.

Leukaemia Research Fund

Web: www.lrf.org.uk

Primarily involved in research and raises funds to these ends. Their web-site includes a comprehensive range of information for patients about leukaemia

Leukaemia Care

2 Shrubbery Avenue Worcester WR1 1QH

Careline: 0800 169 6680 Web: www.leukaemiacare.org.uk

Aims to promote the welfare of those suffering from Leukaemia and allied blood disorders.

Cancer Research UK

Their website www.cancerhelp.org.uk provides facts about cancer and leukaemia including treatment choices.

Other support groups

See [Cancer Support Groups](http://www.patient.co.uk) at www.patient.co.uk for a list of self help and support groups for cancer and leukaemia patients.

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Comprehensive patient resources are available at www.patient.co.uk