



Leukaemia  
Foundation

VISION TO CURE  
MISSION TO CARE

# Myeloproliferative Neoplasms (MPN)

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*A guide for patients and families*



1800 620 420



[leukaemia.org.au](http://leukaemia.org.au)



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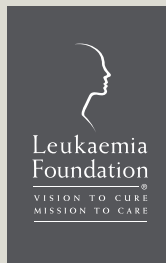
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The Leukaemia Foundation values feedback from people affected by an MPN and the health care professionals working with them. If you would like to make suggestions, or tell us about your experience of using this booklet, please contact the Head of Blood Cancer Support at [info@leukaemia.org.au](mailto:info@leukaemia.org.au)

**July 2015**



# Introduction

*This booklet has been written to help you and your family to understand more about the myeloproliferative neoplasms (MPN).*

Some of you may be feeling anxious or a little overwhelmed if you or someone you care for has been diagnosed with a myeloproliferative neoplasm. This is normal. Perhaps you have already started treatment or you are discussing different treatment options with your doctor and your family. Whatever point you are at, we hope that the information contained in this booklet is useful in answering some of your questions. It may raise other questions, which you should discuss with your doctor, or specialist nurse.

You may not feel like reading this booklet from cover to cover. It might be more useful to look at the list of contents and read the parts that you think will be of most use at a particular point in time.

We have used some medical words and terms, which you may not be familiar with. Their meaning is explained in the booklet and/or in the glossary of terms at the back of the booklet.

Some of you may require more information than is contained in this booklet. We have included some internet addresses that you might find useful. In addition, many of you will receive written information from the doctors and nurses at your treating hospital.

It is not the intention of this booklet to recommend any particular form of treatment to you. You need to discuss your particular circumstances at all times with your treating doctor and team.

Finally, we hope that you find this booklet useful and we would appreciate any feedback from you so that we can continue to serve you and your families better in the future.

# The Leukaemia Foundation

*The Leukaemia Foundation is Australia's peak body dedicated to the care and cure of patients and families living with leukaemia, lymphoma, myeloma and related blood disorders.*

Since 1975, the Foundation has been committed to improving survival for patients and providing much needed support. The Foundation does not receive direct ongoing government funding, relying instead on the continued and generous support of individuals and corporate supporters to develop and expand its services.

The Foundation provides a range of support services to patients at no cost. This support may be offered over the telephone, face to face or online depending on the geographical and individual needs. Support may include providing information, education seminars and programs that provide a forum for peer support and consumer representation, practical assistance, accommodation, transport and emotional support/counselling.

The Leukaemia Foundation also funds leading research into better treatments and cures for MPN and related blood disorders. The Foundation supported the establishment of the ALLG Discovery Centre at the Princess Alexandra Hospital, and the Leukaemia Foundation Research Unit at the Queensland Institute for Medical Research. The Foundation also funds research grants, scholarships and fellowships for talented researchers and health professionals as part of its national research program.



*Foundation staff with health professional qualifications provide patients and their families with information and support across Australia.*

## **Support Services**

*The Leukaemia Foundation has a team of highly trained and caring Support Services staff with qualifications and experience in nursing or allied health that work across the country.*

We can offer individual support and care to you and your family when it is needed.

***Support Services may include:***

### ***Information***

The Foundation has a range of booklets, DVDs, fact sheets and other resources that are available at no cost. These can be ordered via the form at the back of this booklet or downloaded from the website.

### ***Education & Support programs***

The Leukaemia Foundation offers you and your family disease-specific and general education and support programs throughout Australia. These programs are designed to empower you with information about various aspects of diagnosis and treatment and how to support your general health and wellbeing.

### ***Emotional support***

A diagnosis of MPN can have a dramatic impact of a person's life. At times it can be difficult to cope with the emotional stress involved. The Leukaemia Foundation's Blood Cancer Support staff can provide you and your family with much needed support during this time.



### ***Blood Buddies***

This is a program for people newly diagnosed with MPN to be introduced to a trained 'buddy' who has been living with MPN for at least two years, to share their experience, their learning, and to provide some support.

### ***Telephone discussion forums***

This support service enables anyone throughout Australia who has MPN to share their experiences, provide tips, and receive education and support in a relaxed forum. Each discussion is facilitated by a member of the Leukaemia Foundation Blood Cancer Support team who is a trained health professional.

### ***Accommodation***

Some people need to relocate for treatment and may need help with accommodation. The Leukaemia Foundation's staff can help you to find suitable accommodation close to your hospital or treatment centre. In many areas, the Foundation's fully furnished self-contained units and houses can provide a 'home away from home' for you and your family.

### ***Transport***

The Foundation also assists with transporting people to and from hospital for treatment. Courtesy cars and other services are available in many areas throughout the country.

*With the cost of hospital car parking and how difficult it can be to find a car park, the Foundation's transport service has made my hospital visits so much easier.*



*The health system can feel so big and overwhelming. Sometimes I don't even know what questions to ask to get what I need. The Foundation's staff help by pointing me in the right direction.*

### **Practical assistance**

The urgency and lengthy duration of medical treatment can affect everyday life for you and your family and there may be practical things the Foundation can do to help. In special circumstances, the Leukaemia Foundation provides financial support for people who are experiencing financial difficulties or hardships as a result of their illness or its treatment. This assistance is assessed on an individual basis.

### **Advocacy**

The Leukaemia Foundation is a source of support for you as you navigate the health system. While we do not provide treatment recommendations, we can support you while you weigh up your options. We may also provide information on other options such as special drug access programs, and available clinical trials.

### **Contacting us**

The Leukaemia Foundation provides services and support in every Australian state and territory. Every person's experience of living with MPN is different. Living with MPN is not always easy, but you don't have to do it alone. Please call **1800 620 420** to speak to a local support service staff member or to find out more about the services offered by the Foundation. Alternatively, contact us via email by sending a message to **[info@leukaemia.org.au](mailto:info@leukaemia.org.au)** or visit **[www.leukaemia.org.au](http://www.leukaemia.org.au)**

## *Understanding myeloproliferative neoplasms*

*In this section of our booklet we provide a brief overview of MPN. It is important to point out that the information provided here is of a general nature and may not necessarily apply to the specific type or severity of disease you or your loved one has.*

MPN occurs in cells that originate in the bone marrow and are defined by the uncontrolled growth of faulty cells.

To best understand these neoplasms we first need to understand the bone marrow, stem cells and blood.

## *Red Blood Cells*

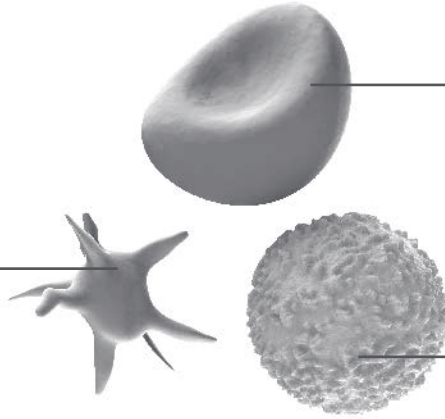
Carry oxygen for the body to produce energy

## *White Blood Cells*

Form part of the immune system

## *Platelets*

Support blood clotting to stop bleeding



# *Getting to know your bone marrow, stem cells and blood*

## **Bone marrow**

*Bone marrow is the spongy tissue that fills the cavities inside your bones. Most of your blood cells are made in your bone marrow.*

The process by which blood cells are made is called *haematopoiesis*. There are three main types of blood cells; red cells, white cells and platelets.

As an infant, haematopoiesis takes place at the centre of all bones. In later life, it is limited mainly to the hips, ribs and breast bone (sternum). Some of you may have had a bone marrow biopsy taken from the bone at the back of your hip (the iliac crest).

You might like to think of the bone marrow as the blood cell factory.

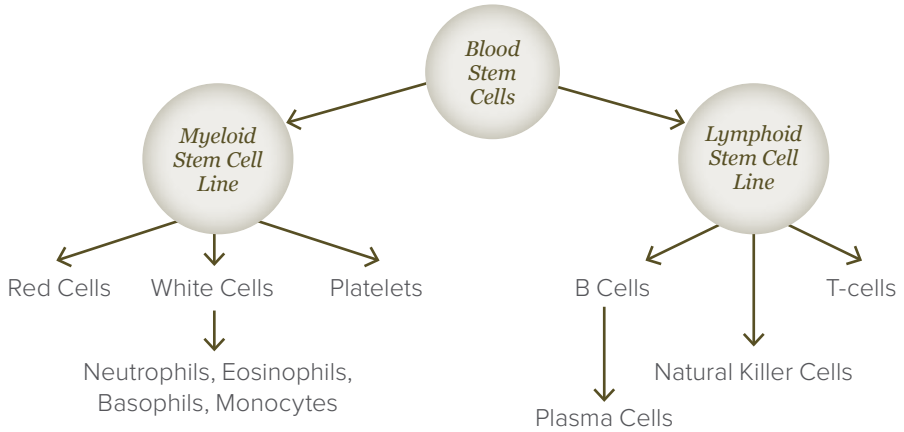
The main workers at the factory are the *stem cells*. They are relatively small in number but are able, when stimulated, to reproduce vital numbers of red cells, white cells and platelets. All blood cells need to be replaced because they have limited life spans.

There are two main families of stem cells, which develop into the various types of blood cells.

**Myeloid** ('my-a-loid') stem cells develop into red cells, white cells (neutrophils, eosinophils, basophils and monocytes) and platelets.

**Lymphoid** ('lim-foid') stem cells develop into other types of white cells including T-cells, B-cells and Natural Killer Cells.

## Blood cell formation:



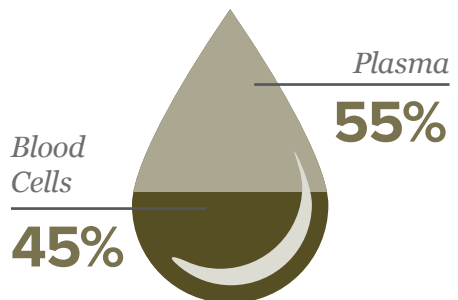
## Growth factors and cytokines

All normal blood cells have a limited lifespan in the circulation and need to be replaced on a continual basis. This means that the bone marrow remains very active throughout life. Natural chemicals circulating in your blood called growth factors, or cytokines, control this process of blood cell formation. Each of the different blood cells is produced from stem cells under the guidance of a different growth factor.

Some of the growth factors can now be made in the laboratory (synthesised) and are available for use in people with blood disorders. For example, granulocyte colony-stimulating factor (G-CSF) stimulates the production of certain white cells, including *neutrophils*, while erythropoietin (EPO) stimulates the production of red cells.

## Blood

Blood consists of blood cells and plasma. Plasma is a straw-coloured fluid that blood cells use to travel around your body and also contains many important proteins and chemicals.



## Blood cells

### *Red cells and haemoglobin*

Red cells contain haemoglobin (Hb) which gives the blood its red colour and transports oxygen from the lungs to all parts of the body. The body uses this oxygen to create energy.

### *Haematocrit*



About 99% of all blood cells in circulation are red blood cells. The percentage of the blood that is occupied by red blood cells is called the haematocrit. A low haematocrit suggests that the number of red cells in the blood is lower than normal.

### *Anaemia*

Anaemia is a reduction in the number of red cells or low haemoglobin. Measuring either the haematocrit or the haemoglobin will provide information regarding the degree of anaemia.

If you are anaemic you may feel rundown and weak. You may be pale and short of breath or you may tire easily because your body is not getting enough oxygen. In this situation, a blood transfusion may be given to restore the red blood cell numbers and therefore the haemoglobin to more normal levels.

## Normal ranges for adults:

	 <b>Men</b>	 <b>Women</b>
<i>Haemoglobin (Hb)</i>	130 – 170 g/L	120 – 160 g/L
<i>Haematocrit (Hct)</i>	40 – 52%	36 – 46%
<i>White cell count (WBC)</i>	3.7 – 11.0 × 10 <sup>9</sup> /L	
<i>Neutrophils (neut)</i>	2.0 – 7.5 × 10 <sup>9</sup> /L	
<i>Platelets (Plt)</i>	150 – 400 × 10 <sup>9</sup> /L	

## **White cells**

White cells, also known as leukocytes, fight infection. The following is a list of some of the different types of white cells:

**Neutrophils:** Mainly kill bacteria and remove damaged tissue. Neutrophils are often called the first line of defence when infections occur. They are often the first white blood cell at the site of infection and attempt to destroy the foreign pathogen before it becomes a problem to the body.

**Eosinophils:** Mainly kill parasites

**Basophils:** Mainly work with neutrophils to fight infection

**Monocytes:** Mainly work with neutrophils and lymphocytes to fight infection; they also act as scavengers to remove dead tissue. These cells are known as monocytes when found in the blood, and called macrophages when they migrate into body tissue to help fight infection.

**B-cells:** Mainly make antibodies that target micro-organisms, particularly bacteria.

**T-cells:** Mainly kill viruses, parasites and cancer cells and produce cytokines which can recruit other cells to make antibodies which target micro-organisms.

These white cells work together to fight infection as well as having unique individual roles in the fight against infection.



### **Neutropenia**

Neutropenia is the term given to describe a lower than normal neutrophil count. If you have a neutrophil count of less than  $1 (1 \times 10^9/L)$ , you are at an increased risk of developing more frequent and sometimes severe infections.

### **Platelets**

Platelets are cellular fragments that circulate in the blood and play an important role in clot formation. They help to prevent bleeding.

If a blood vessel is damaged (for example by a cut) the platelets gather at the site of the injury, stick together and form a plug to help stop the bleeding. They also release chemicals, called clotting factors that are required for the formation of blood clots.

### **Thrombocytopenia**

Thrombocytopenia is the term used to describe a reduction in the platelet count to below normal. If your platelet count drops too low, you are at an increased risk of bleeding and tend to bruise easily. Each treatment centre will have their own guidelines on the specific platelet count level when interventions may need to be taken. Platelet transfusions are sometimes given to return the platelet count to a safer level.

*To prevent infections, regular washing of my hands has become part of my new normal.*

## *Myeloproliferative neoplasms*

*'Myelo' is the Greek word for marrow and 'proliferative' is another word for growing or reproducing. Myeloproliferative neoplasms are a group of disorders in which the bone marrow cells grow and reproduce abnormally.*

In the myeloproliferative neoplasms, abnormal bone marrow stem cells produce excess numbers of one or more types of blood cells (red cells, white cells and/or platelets). These abnormal cells change the thickness of the blood, and sometimes have abnormal function. MPNs can cause serious health problems unless properly treated and controlled.





It is important to remember, as you read through this booklet, that myeloproliferative neoplasms are chronic diseases that, in most cases, remain stable for many years or progress gradually over time. The symptoms and complications of myeloproliferative neoplasms described in this booklet do not occur in everyone, and may not occur for many years.

## Are myeloproliferative neoplasms cancers?

The term 'cancer' describes a group of diseases where there is an overgrowth of one type of cell in the body. For a cancer to become most dangerous, two things need to happen. Firstly, the cells need to grow excessively. Secondly, the cells need to not function normally and may invade and damage adjacent (normal) cells.

Myeloproliferative neoplasms are cancers as the cells in the bone marrow are growing excessively. However, in general the cells function normally like normal blood cells. Damage to adjoining cells is usually due to the large number of cells produced in MPN.

Over a long period of time, some people with myeloproliferative neoplasms may develop the second step whereby cells start functioning abnormally, leading to an acute leukemia (a more aggressive cancer).

## Types of myeloproliferative neoplasms

Myeloproliferative neoplasms are usually described according to the type of blood cell which is most affected. There are four main types of myeloproliferative neoplasms that together represent around 95% of all cases:

- Chronic myeloid leukaemia (CML) – too many white cells - refer to our separate CML booklet
- Polycythaemia vera (PV) – too many red cells
- Essential thrombocythaemia (ET) – too many platelets
- Myelofibrosis (MF) – bone marrow tissue is replaced by fibrous scar-like tissue.

PV, ET and MF are closely related diseases, so it is not uncommon for people to have features of more than one of these diseases when they are first diagnosed, or during the course of their illness. In some cases, one of these diseases may transform over time to another.

All myeloproliferative neoplasms can transform into a type of leukaemia called acute myeloid leukaemia (AML).

Less common types of myeloproliferative neoplasms include:

- Chronic neutrophilic leukaemia (CNL) – too many neutrophils (a type of white cell) in blood and bone marrow
- Chronic eosinophilic leukaemia (CEL) / hypereosinophilic syndrome – too many eosinophils (another type of white cell) in blood and bone marrow
- Chronic myelomonocytic leukaemia (CMML) – too many monocytes (a type of white cell). It has features of being both an MPN and an MDS. You can find more information on CMML in the MDS booklet.
- Systemic mastocytosis (SM) – too many mast cells (a type of white cell) in blood, bone marrow, skin and other tissues.
- Myeloproliferative neoplasms– unclassifiable

## Causes

*The exact cause of the myeloproliferative neoplasms remains unknown, but there are likely to be a number of factors involved. The myeloproliferative neoplasms are monoclonal blood stem cell disorders. This means that they result from a change, or mutation, in the DNA (genetic code) of a single stem cell, which acquires abnormal growth patterns.*

This change results in abnormal blood cell development and the overproduction of blood cells. In the myeloproliferative neoplasms, the original mutation is preserved when the affected stem cell divides (proliferates) and produces a 'clone'; a group of identical stem cells all with the same genetic defect.

Mutations in dividing cells occur all the time and healthy cells have complex mechanisms within them to stop these abnormalities persisting. But the longer we live, the more chance we have of acquiring mutations that manage to escape these safeguards. That is why the myeloproliferative neoplasms, like most leukaemias and other cancers, become more common as we get older.

Myeloproliferative neoplasms are not contagious; you cannot 'catch' the disorders by being in contact with someone who has one. Most people with a myeloproliferative neoplasm have no family history of the disease.

*For me fatigue is my worst side-effect. It is more than just feeling tired and it is hard to explain to others how it feels.*

# Diagnosis

*The specific diagnosis of the various forms of MPN require different testing techniques, but all have the following tests in common:*

- full blood count
- bone marrow biopsy
- genetic mutation testing
- physical examination

When you first see your general practitioner (GP), he or she will take your full medical history, asking questions about your general health and any illness or surgery you have had in the past. The doctor will conduct a careful physical examination looking for any signs of disease, such as an enlarged spleen, liver or lymph nodes, and take a routine blood test to check your blood count.

## Splenomegaly

The spleen is located on the left hand side of the abdomen and has two main functions. It filters blood and removes any old or dead cells, such as red blood cells. These cells are removed by specialised white blood cells called macrophages. Macrophages literally ‘eat’ the old or dead cells by engulfing them.

The spleen also has an immune function. Lymphocytes reside in the spleen and screen the blood passing through it for any infections. Any pathogens found are immediately destroyed.

The spleen also acts as a reservoir or ‘storage site’ for red blood cells and platelets. This is particularly useful during emergencies such as bleeding or shock.

An enlarged spleen (splenomegaly) is common in people with MPN. In most instances this is due to the increased workload placed on the spleen - a consequence of the high numbers of cells being produced in the bone marrow - which are then destroyed in the spleen. The spleen tries to keep up with the increased workload by increasing in size.

Symptoms include feelings of discomfort, pain or fullness in the upper left side of the abdomen. An enlarged spleen may also cause pressure on the stomach causing a feeling of fullness, indigestion and a loss of appetite.

In some cases the liver may also be enlarged (hepatomegaly). Other symptoms include weight loss, bone pain and generalised itching. Splenomegaly more commonly occurs in the MPN subtypes, polycythaemia vera and myelofibrosis – where virtually all patients have an enlarged spleen at diagnosis.

## Full blood count

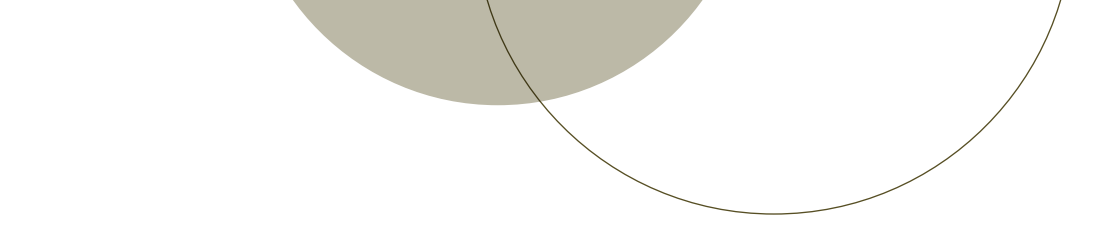
The first step in diagnosing MPN requires a simple blood test called a full blood count (FBC) or complete blood count (CBC). This involves taking a sample of blood from a vein in your arm, and sending it to the laboratory for examination under the microscope.

The number of red cells, white cells and platelets, and their size and shape, is noted as these can all be abnormal if you have an MPN.

## Bone marrow examination

A bone marrow examination (bone marrow biopsy) involves taking a sample of bone marrow, usually from the back of the iliac crest (hip bone) or from the sternum (breast bone) and sending it to the laboratory for examination under the microscope.

The bone marrow examination may be done in the haematologist's rooms or clinic under local anaesthesia or, in selected cases, under a short general anaesthetic in a day procedure unit. A mild sedative and a pain-killer is given beforehand and the skin is numbed using a local anaesthetic; this is given as an injection under the skin. The injection takes a minute or two, and you should feel only a mild stinging sensation.



After allowing time for the local anaesthetic to work, a long needle is inserted through the skin and outer layer of bone into the bone marrow cavity. A syringe is attached to the end of the needle and a small sample of bone marrow fluid is drawn out - this is known as a 'bone marrow aspirate'. Then the needle is used to obtain a small core of bone marrow which will provide more detailed information about the structure of the bone marrow and bone - this is known as a 'bone marrow trephine'.

22 Because you might feel a bit drowsy afterwards, you should take a family member or friend along who can take you home. A small dressing over the biopsy site can be removed the next day. There may be some mild bruising or discomfort, which usually is managed effectively by paracetamol. More serious complications such as bleeding or infection are very rare.

## Cytogenetic and molecular genetic tests

Cytogenetic ('cy-to-gen-etic') tests provide information about the genetic make-up of the MPN cells, in other words, the number, structure and abnormalities in the chromosomes present. Chromosomes are the structures that carry genes. Standard cytogenetic tests involve examining the chromosomes under the microscope.

Molecular genetic tests are more sophisticated genetic tests that may be used to assess how well your disease has responded to treatment. These tests are capable of measuring minute traces of leftover (residual) MPN cells not normally visible under the microscope. This gives the doctor some indication of the course of your disease. Using this highly sensitive technology, subtle changes in your disease can be detected earlier and where necessary treated earlier. This test may be done either with a blood or a bone marrow sample.

Further tests may be required to identify which specific type of MPN you have. These are described in each disease-subtype chapter later in the booklet.



## *Polycythaemia (rubra) vera*

*Polycythaemia (rubra) vera (PV) is a disorder in which too many red cells are produced in the bone marrow. These cells accumulate in the bone marrow and in the blood stream where they increase the blood volume and cause the blood to become thicker, or more 'viscous' than normal. In many people with PV, too many platelets and white cells can also be produced.*

PV is a rare chronic disease diagnosed in an estimated 250 people in Australia each year. Although it can occur at any age, PV usually affects older people, with most patients diagnosed over the age of 50. PV is rare in children and young adults. It occurs more commonly in males than in females.

## **Secondary or reactive polycythaemia**

In secondary or reactive polycythaemia, red cell production is increased in response to excess amounts of erythropoietin (a red cell growth factor) circulating in the bloodstream.

Erythropoietin is a useful compensatory mechanism that helps the body to produce more red cells and haemoglobin to transport more oxygen around the body.

In a condition known as relative, apparent or spurious polycythaemia, the volume of plasma (the liquid portion of the blood) is reduced, usually as a result of dehydration, vomiting or diuretic (fluid loss) therapy. This increases the concentration of red cells in the blood but the actual total number of red cells remains normal.

## Symptoms

Many people have no symptoms when they are first diagnosed with PV and the disease is often picked up incidentally during a routine blood test or physical examination.

When symptoms do occur, they usually develop gradually over time. They are mainly due to the increased thickness and abnormally high numbers of blood cells in the circulating blood. Common symptoms include:

- headaches
- blurred vision
- fatigue
- weakness
- dizziness
- itchiness (pruritus), especially after a hot bath
- high blood pressure
- enlarged spleen, and sometimes enlarged liver
- night sweats
- bone pain.

Some people experience gout, which usually presents as a painful inflammation of the big toe or foot. This can result from a build up of uric acid, a by-product of the increased production and breakdown of blood cells.

Some individuals may develop erythromelalgia, a rare condition that primarily affects the feet and, less commonly, the hands. It is characterised by intense, burning pain of affected extremities, and an increased skin temperature that may be episodic or almost continuous in nature.

In many cases, people with PV have a ruddy (red) complexion, and a reddening of the palms of the hand and soles of the feet, ear lobes, mucous membranes and the eyes. This is due to the high numbers of red cells in the circulation.



### ***Blood clots (thrombosis) and bleeding***

As the blood is thicker than normal in people with PV, it cannot flow as easily, especially through the smaller blood vessels. If left untreated, this increases the risk of thrombosis, the formation of a blood clot within a blood vessel.

Blood clots can form in various parts of the body including the veins of the legs, in the heart (causing a myocardial infarction, or heart attack), in the lungs (causing a pulmonary embolism) and in the brain (causing a stroke).

Blood clots are a common complication of PV and occur in around 30 per cent of people, even before they are diagnosed. Older people and those with a history of a previous blood clot are at increased risk. The major aim of treatment in PV is to maintain a normal blood count and reduce your risk of thrombosis.

Bleeding and easy bruising can also occur. This is usually minor and occurs in around one quarter of all patients. Occasionally bleeding into the gut can be prolonged or severe.

## **Diagnosis**

PV is diagnosed using a combination of laboratory tests and a physical examination.

### ***Full blood count***

People with PV have a high red cell count, haemoglobin level and haematocrit. The haematocrit is the proportion of the whole blood that is made up of red cells.

A raised white cell count (especially a raised neutrophil count) and a raised platelet count are also common findings.

### ***JAK2 mutation testing***

JAK2 mutations (particularly the V617F mutation) can be found in almost all people with PV. This test can be performed on a blood sample and will help to confirm the diagnosis of PV. It doesn't help distinguish PV from essential thrombocythaemia or primary myelofibrosis.

### ***Bone marrow examination***

In PV, the bone marrow is often very active with abnormally high numbers of cells. Iron stores may be depleted since iron is being used to make more and more red cells.

### **Bone marrow aspirate and biopsy**

A procedure that involves removing a sample of the liquid bone marrow and a small core of bone marrow for examination in the laboratory. The biopsy is taken under local or general anaesthetic from the back of the pelvis (hip girdle).

### ***Other possible tests***

- Chest x-ray – to rule out lung disease (as lung disorders can lead to low oxygen, which can produce high red cell numbers without there being an MPN)
- Abdominal ultrasound and/or CT scan – to rule out kidney disease and measure spleen/liver size.

### ***Other possible blood tests***

- Serum vitamin B-12 levels
- Uric acid levels
- Erythropoietin levels
- Coagulation studies (to see if your blood is clotting normally)
- Blood oxygen levels.



## Treatment

The goal of treatment for PV is to reduce the number of cells in your blood and help you to maintain a normal blood count. This helps control any symptoms of your disease and reduces the risk of complications due to blood clotting, or bleeding.

The treatment, or combination of treatments, chosen for you will depend on several factors, including the duration and severity of your disorder, whether or not you have a history of blood clots, your age and your general health.

### **Venesection**

Venesection (or phlebotomy) is a procedure in which a controlled amount of blood is removed from your bloodstream. This procedure is commonly used when people are first diagnosed with PV because it can help to rapidly reduce a high red cell count.

In a process similar to a blood donation, 450 to 500ml of your blood is removed, usually from a large vein in the arm, inside the elbow bend. This is usually done in the outpatient's department of the hospital. It takes about 30 minutes to complete. You must make sure you drink plenty of water before and after the procedure.

This procedure may need to be repeated frequently at first, usually every few days, until your haematocrit is reduced to the desired level. The target haematocrit level is <45% in men and <42% in women. After this, you may need to have the procedure repeated periodically, for example at monthly intervals, to help maintain a normal blood count.

For many people, particularly younger patients and those with mild disease, regular venesection (every few months) may be all that is needed to control their disease for many years.

Many people with PV also need other treatments in addition to, or instead of, venesection to help control their blood count.

### **Chemotherapy**

Chemotherapy is commonly used to reduce blood cell production in the bone marrow. Chemotherapy drugs are commonly used for people with high risk of heart attacks or strokes (due to previous history, or older age), complications due to blood clotting or bleeding, or symptoms of an enlarged spleen. They are also used for some people who are unable to tolerate venesection or whose disease is no longer responding to venesection.

The most commonly used chemotherapy drug is hydroxyurea. Hydroxyurea is taken in the form of a capsule at home every day. As hydroxyurea is known to cause damage to unborn babies, it should not be taken during pregnancy. If this could be an issue for you, you should ask your haematologist about your options. Chemotherapy taken in capsule form is tolerated well by most people and side-effects tend to be few and mild.

Another less commonly used chemotherapy drug is busulphan. This drug is given in tablet form.

As these drugs work by suppressing blood formation, periodic blood tests should be performed when taking these drugs to monitor the blood count and to guard against severe reductions in the white cell or platelet counts.

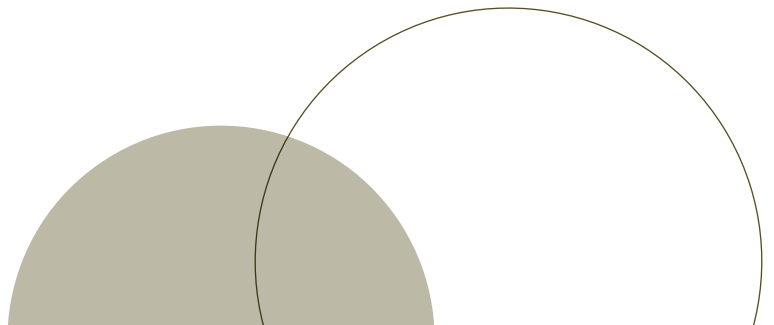
In some people leg ulcers and ongoing fevers may occur. You should discuss this with your doctor immediately if you experience any of these symptoms.

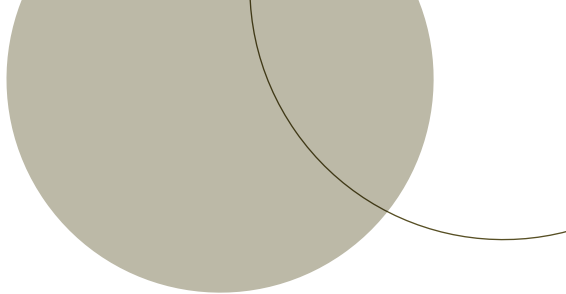
### ***Interferon***

Interferon is a substance produced naturally by the body's immune system. It plays an important role in fighting disease. In PV, interferon is sometimes prescribed for younger patients to help control the production of blood cells.

Interferon is usually given three times a week as an injection under the skin (subcutaneous injection) using a very small needle. You or a family member (or friend) will be taught how to do this at home.

Side-effects of interferon can be unpleasant but they can be minimised by starting with a small dose, and building up to the full dose over several weeks. The main side-effects are flu-like symptoms such as chills, fevers, nausea, headache, aches and pains and weakness.





Your doctor or nurse will explain any side-effects you might experience while you are having these treatments and how they can be managed. Some of these side-effects can be managed by taking paracetamol before the injections, taking the injections at bedtime, and by drinking lots of fluids.

Interferon treatment can cause feelings of low mood and depression. If this occurs it is important to discuss it with your doctor, as medication can be prescribed to help treat this side-effect.

## Other treatments

### *Aspirin*

Many people are prescribed small daily doses of aspirin, which has been shown to significantly reduce the risk of developing clots in people with PV. Aspirin works by preventing your platelets from clumping together.

Aspirin can irritate your stomach lining, which can result in pain or discomfort in the stomach, causing nausea, heartburn or loss of appetite. Taking your aspirin with food or milk may help prevent this.

In addition, many people are prescribed specially-coated aspirin that allows the drug to pass through the stomach and

into the intestine before being dissolved. This helps to reduce the risk of stomach upset. You should see your doctor if you are experiencing stomach upset while on aspirin.

Aspirin is taken at home in tablet form. Drug interactions can occur, so it is important to avoid taking other medications while you are on aspirin, unless you are advised to do so by your doctor.

### *Anagrelide hydrochloride*

Anagrelide hydrochloride (Agrylin®) is a drug used to reduce high platelet counts in people with PV and essential thrombocythaemia.

Anagrelide affects platelet-producing cells in the bone marrow called megakaryocytes, slowing down platelet production and therefore reducing the number of platelets in the circulating blood. This can help to reduce symptoms and the risk of clotting complications in the future.

Although Anagrelide lowers platelet counts to more normal levels, it does not affect the body's natural process to form a clot when needed. Anagrelide is taken in capsule form. It can be taken with or without food. The capsule strength and the number of times a day you need to take Anagrelide will depend on your platelet count, your response to treatment and how well you tolerate the drug.

Your doctor will keep track of your response to Anagrelide and adjust your dose as needed to maintain your platelet count at the desired level. Side-effects can range from mild to severe but may decrease with continued therapy. The most commonly reported side-effects include: headaches; fast or forceful heart beat (palpitations); diarrhoea; weakness; fluid retention; nausea; dizziness; abdominal pain; and shortness of breath.

You should report any side-effects you are experiencing to your doctor as many of them can be treated to reduce your discomfort. You need to contact your doctor immediately if you experience any of the following symptoms:

- shortness of breath or difficulty breathing
- swollen ankles
- fast or irregular heartbeat
- chest pain.

You should not stop taking this or any other medication for PV unless instructed by your doctor. Stopping these medications suddenly can be harmful.

## Prognosis

A prognosis is an estimate of the likely course of a disease. The natural course of PV can vary considerably between individuals. In many patients, with treatment the disease remains stable for long periods of time, often many years.

In some people, PV progresses over time into myelofibrosis or rarely into acute myeloid leukaemia, despite treatment. The spleen may become increasingly enlarged. Anaemia and thrombocytopenia (low numbers of platelets) is common as the bone marrow is no longer able to produce adequate numbers of red cells or platelets. In addition, abnormal immature blood cells, known as blast cells, may start to appear in the blood.

Treatment at this time focuses on managing symptoms and involves making every effort to improve the person's quality of life. This may involve blood transfusions, pain relief and careful suppression of your bone marrow. In selected cases, surgical removal of the spleen, or low dose radiation to the spleen may be required to relieve symptoms.

Your doctor is the best person to give you an accurate prognosis regarding your disease as he or she has all the necessary information to make this assessment.

# *Essential thrombocythaemia (ET)*

*Essential thrombocythaemia (ET) is a disorder in which too many platelets are produced in the bone marrow. Platelets are normally needed in the body to control bleeding. However, excess numbers of platelets can lead to abnormal blood clotting, which can block the flow of blood in the blood vessels.*

There are a number of conditions that can cause a rise in the number of platelets in the circulating blood (thrombocytosis). These include bleeding, infection and some types of cancer. In ET, however, the blood platelet count is persistently elevated as a result of increased bone marrow production of platelets, in the absence of any identifiable cause.

Like polycythaemia vera, ET is a rare chronic disease diagnosed in an estimated 200 people in Australia each year. Although it can occur at any age, even (rarely) in children, ET usually affects older people, with most patients diagnosed between the ages of 50 and 70. It occurs more frequently in females than males.

## Symptoms

Many people have no symptoms when they are first diagnosed with ET and their disease is picked up incidentally during a routine blood test. However, if symptoms do occur, they generally include tingling or burning in the hands and feet, headache, visual problems, weakness and dizziness.

These symptoms and others result from excessive numbers of platelets causing blockages in small or large blood vessels in different parts of the body.

### ***Blood clots and bleeding***

Blood clots (thrombosis) can be a major complication of ET. Older patients and people with a prior history of thrombosis may be at increased risk. For people with an increased risk of forming blood clots, a major aim of treatment is to reduce your platelet count. In some people without an increased risk of thrombosis, the platelet count may be safely observed and allowed to remain at a higher level than normal.

Blood clots can occur in large or small arteries interfering with the blood flow and therefore oxygen supply to various organs or tissues. Blockages in the smaller blood vessels in the toes and fingers can cause redness of the skin and burning and throbbing pains. These pains are often made worse by heat or exercise and relieved by cooling and elevating the affected area. These symptoms are often dramatically improved using small daily doses of aspirin, and/or reducing the patient's platelet count.

Blockages in the arteries supplying the heart (causing a myocardial infarction, or heart attack), brain (causing a stroke) or kidneys can be serious and can lead to significant tissue damage or ischaemia (tissue death).





Blood clots can also develop in the veins of the legs (causing deep vein thrombosis), and less commonly, the spleen and liver. This blocks blood flow and causes pain in these areas.

A blood clot that breaks off the wall of the vein and travels in the blood stream is known as an embolism. When an embolism travels to the lungs, it is known as a pulmonary embolism and can cause breathing problems, and may in some cases be fatal.

Less commonly, people experience symptoms of abnormal bleeding including bruising for no apparent reason, or exaggerated or prolonged bleeding following minor cuts or injury. Some people notice frequent or severe nose bleeds or bleeding gums and some women may have unusually heavy menstrual periods.

This can occur when the platelet level is very high. A clotting factor known as von Willebrand factor, which helps in the body's clotting process, is used up by the excess number of platelets in the blood and becomes deficient in the body. The aim of treatment is to reduce the platelet count.

In pregnancy, uncontrolled ET can reduce the blood supply to the placenta or foetus. This can cause problems with foetal growth and may in some cases lead to miscarriage.

## Diagnosis

The diagnosis of ET is only made when other causes of a raised platelet count have been excluded.

### *Full blood count*

A persistently raised platelet count is the most common sign of ET. The platelet count can range from slightly higher than normal to many times higher than normal. Under the microscope the platelets may appear different from normal and may be large and pale blue-stained.

### ***Bone marrow examination and gene mutation tests***

In ET, the bone marrow is usually normal apart from an excess number of abnormal megakaryocytes, which are the platelet producing cells in the bone marrow.

Molecular analysis of blood cells can also help to make a diagnosis of ET. A mutation in the JAK2 gene is found in a significant proportion (50-60%) of people with ET.

Mutations in the MPL gene account for approximately 10% of cases. Another 30% of people with ET have a mutation in the CALR gene.

Other blood tests may be done to check your general health and how well your kidneys, liver, thyroid and other vital organs are functioning.

## **Treatment**

The goal of treatment for people with ET is to prevent complications like abnormal bleeding and bruising and, in some cases, to reduce the number of platelets in the blood. You may not have any symptoms of ET when you are first diagnosed and therefore may not require any treatment for some time.

Instead your doctor may recommend a 'watch and wait' strategy that involves regular check-ups and blood counts to carefully monitor your health.

In addition, he or she will advise you on the steps you can take to stay healthy and reduce any lifestyle-related risk factors you may have that increase your chances of developing a blood clot. You may be advised, for example, on ways to help you stop smoking and/or maintain a healthy weight range, blood pressure and cholesterol levels.

For some people, ET will require some form of treatment to reduce their platelet count and therefore their risk of thrombosis. The treatment chosen for you will depend on a number of factors that influence your particular risk of complications due to thrombosis or bleeding.

These include your age, platelet count and whether or not you have had any previous episodes of blood clots or bleeding in the past. A history of smoking or high blood pressure can affect your risk of thrombosis. These factors and others are taken into account when planning the most appropriate treatment for your disease.

For people at high-risk of thrombosis, a chemotherapy drug called hydroxyurea is often used as first-line treatment, usually in combination with low-dose aspirin. Hydroxyurea works by suppressing the function of your bone marrow and thereby controlling platelet production. Aspirin prevents your platelets from clumping together (aggregating) and forming harmful clots in your body.

Anagrelide hydrochloride (Agrislin®) and interferon may also be used. Anagrelide slows down platelet production in your bone marrow, thereby helping to reduce symptoms and your risk of thrombosis. Interferon works by suppressing the abnormal megakaryocyte clone in your bone marrow, thereby reducing the overproduction of platelets.

Those at low-risk of thrombosis may be simply treated using low-dose aspirin or an equivalent drug alone. Your doctor will be able to discuss with you all of the treatment options suitable for you.

## Prognosis

ET is regarded as an incurable disease but in many people who receive treatment the disease remains stable for long periods of time. In the longer term, a small number of people with ET may develop myelofibrosis. There is also a relatively low (<1%) risk of ET transforming to acute myeloid leukaemia.

Your doctor is the best person to give you an accurate prognosis regarding your disease as he or she has all the necessary information to make this assessment.

# Primary myelofibrosis

*Primary myelofibrosis is a disorder in which normal bone marrow tissue is gradually replaced with a fibrous scar-like material. Over time, this leads to progressive bone marrow failure.*

Under normal conditions, the bone marrow provides a fine network of fibres on which the stem cells can divide and grow. Specialised cells in the bone marrow known as fibroblasts make these fibres.

In myelofibrosis, chemicals released by high numbers of platelets and abnormal megakaryocytes (platelet forming cells) over-stimulate the fibroblasts. This results in the overgrowth of thick coarse fibres in the bone marrow, which gradually replace normal bone marrow tissue.

Over time, this destroys the normal bone marrow environment, preventing the production of adequate numbers of red cells, white cells and platelets. This results in anaemia, low platelet counts and the production of blood cells in areas outside the bone marrow for example in the spleen and liver, which become enlarged as a result.

Myelofibrosis is a rare chronic disorder diagnosed in an estimated 150 people in Australia each year. It can occur at any age but is usually diagnosed later in life, between the ages of 60 and 70 years.

The cause of myelofibrosis remains largely unknown. It can be sub-classified depending upon the presence or absence of the JAK2, MPL or CALR gene mutations that are associated with the MPNs.

Long-term exposure to high levels of benzene or very high doses of ionising radiation may increase the risk of primary myelofibrosis in a small number of cases. Around one third of people with myelofibrosis have been previously diagnosed with polycythaemia (post-polycythaemic myelofibrosis) or essential thrombocythaemia (post-thrombocythaemic myelofibrosis).

## Symptoms

Around 20% of people have no symptoms of primary myelofibrosis when they are first diagnosed and the disorder is picked up incidentally as a result of a routine blood test.

For others, symptoms develop gradually over time. Symptoms of anaemia are common and include unexplained tiredness, weakness, shortness of breath and heart palpitations.

Other symptoms may include fever, unintended weight loss, pruritus (generalised itching) and excess sweating, especially at night. Less common symptoms include bone and joint pain, and bleeding problems.

## Diagnosis

Primary myelofibrosis is diagnosed using a combination of a physical examination showing the presence of an enlarged spleen, blood tests and a bone marrow examination. It is only diagnosed when other causes of marrow fibrosis (including leukaemia, lymphoma and other types of cancer that have spread to the bone marrow) have been ruled out.

### **Full blood count**

People with myelofibrosis commonly present with varying degrees of anaemia. When examined under the microscope the red cells are often described as being 'teardrop-shaped'. It is not known why they are this shape.

Higher than normal numbers of white cells and platelets may be found in the early stages of this disorder, but low white cell and platelet counts are common in more advanced disease.

### **Bone marrow examination**

It is frequently impossible to obtain any samples of bone marrow fluid using a needle and syringe (bone marrow aspiration) due to marrow fibrosis. This is known as a 'dry tap'.

The bone marrow trephine biopsy (removing a small core of the bone marrow) typically shows abnormal fibrosis of the marrow cavity and reduced numbers of normal bone marrow cells.

Molecular analysis of blood and bone marrow cells is also carried out to help confirm the diagnosis and may help with prognosis. A mutation in the JAK2 gene is found in about 50% of people with primary myelofibrosis; another 30% instead have a mutation in the CALR gene, and 10% in the MPL gene.

## Treatment

Some people have no symptoms when they are first diagnosed with myelofibrosis and do not require treatment straight away. They only require regular check-ups with their doctor to carefully monitor their disease.

For others, treatment is aimed at preventing complications due to low blood counts and an enlarged spleen (splenomegaly). This involves making every effort to improve your quality of life by relieving any symptoms and preventing and treating any complications that might arise from your disease or its treatment. This may include periodic blood transfusions and taking antibiotics to treat any infections.

A chemotherapy drug such as hydroxyurea, or low-doses of a drug called thalidomide may be used to reduce an enlarged spleen. In some cases, the surgical removal of the spleen (splenectomy) may be considered, especially when your spleen has enlarged so much that it is causing severe symptoms.

A splenectomy may also be considered if you have an increased need for blood transfusions. This sometimes happens because the spleen is destroying blood cells, particularly platelets, at a very fast rate.

Small doses of radiation to the spleen can also be given to reduce its size. This usually provides temporary relief for about three to six months.

Some younger patients who have a suitably matched donor may be offered an allogeneic (donor) stem cell transplant. This is a medical procedure that offers the only chance of cure for patients with myelofibrosis.

It involves the use of high doses of chemotherapy, with or without radiotherapy, followed by infusion of stem cells, which have been donated by a suitably matched donor. Stem cell transplants carry significant risks and are only suitable for a small minority of strong and healthy patients (usually under 60 years of age).

### **JAK2 Inhibitors**

JAK2 inhibitors work by blocking the activity of the JAK2 protein, which may lead to a reduction in splenomegaly and decreased symptoms. They also work in patients with myelofibrosis without the JAK2 mutation. Side-effects may include worsening anaemia, a low platelet count, or a reduced white cell count.

Ruxolitinib is the only JAK2 inhibitor currently licenced for use in Australia by the Therapeutic Goods Administration (TGA). A number of JAK2 inhibitors may be available in clinical trials or may become available in the near future.

## Blood and platelet transfusions

If symptoms of anaemia are interfering with your normal daily activities, your doctor may recommend that you have a blood transfusion.

Platelet transfusions are sometimes given to prevent or treat bleeding (for example a persistent nose bleed) when the platelet count is low.

You do not need to be admitted to hospital for a blood or platelet transfusion. They are usually given in the outpatient department. Transfusions these days are relatively safe and they don't usually cause any serious complications. Nevertheless you will be carefully monitored throughout the transfusion.

In the meantime, remember to call the nurse if you are feeling hot, cold and/or shivery or in any way unwell during the transfusion, as this might indicate that you are having a reaction. Steps can be taken to minimise these symptoms and ensure that they don't happen again.

## Prognosis

Primary myelofibrosis is generally regarded as an incurable disease but with treatment many people can remain comfortable and symptom-free for some time.

The natural course of the disease can vary considerably between individuals. In some people, their disease remains stable for long periods and they are free to live a normal life with minimal interruptions from their disease or its treatment.

For others, myelofibrosis progresses more quickly and people require treatment to help relieve symptoms of their disease. Transformation to a type of leukaemia called acute myeloid leukaemia occurs in between 10 and 20 per cent of cases.

Your doctor is the best person to give you an accurate prognosis regarding your disease as he or she has all the necessary information to make this assessment.

# *Chronic eosinophilic leukaemia (CEL) and hypereosinophilic syndrome (HES)*

*Eosinophils are a type of white blood cell that play a role in the body's immune defences against foreign pathogens, such as parasites. The function of eosinophils are varied and include immune defence against parasites, allergic responses, tissue inflammation and immunity.*

CEL is a monoclonal (derived from a single stem cell) disorder in which too many eosinophils are made in the bone marrow. These mature cells spill out of the bone marrow and accumulate in the blood and other tissues around the body, including organs such as the heart.

HES can be a monoclonal disorder as a result of a genetic mutation (FIP1L1-PDGFR mutation). This type of HES is known as primary HES. HES can also occur as a result of another disease or malignancy. When this happens, it is known as secondary HES.

In this booklet we will discuss CEL and (primary) HES only.

CEL and HES can both possess a mutation in the FIP1L1-PDGFR alpha gene. This gene has been linked to the overproduction of eosinophils. CEL is different to HES due to the presence of blast cells (immature blood cells) in the bone marrow (>5% blasts), or in the peripheral blood (>2% blasts). CEL may also have abnormal genetic mutations.

People who are diagnosed with HES can go on to develop CEL. CEL may remain stable for many years or it may quickly progress and transform into an acute leukaemia.

CEL and HES are rare chronic diseases and are diagnosed in an estimated 15 people in Australia each year. They affect more men than women. The common age of diagnosis is between 20 and 50 years. Although rare, CEL and HES can occur in children.



## Symptoms

Some people with CEL and HES don't have any symptoms and the disease is picked up incidentally during a routine blood test.

Others may go to their doctor because they have one or more of a range of symptoms including fever, fatigue, cough, muscle pains, pruritus (generalised itching) and diarrhoea.

The symptoms are due to the eosinophils releasing their contents into the surrounding tissues and organs. The eosinophils cause inflammation and damage to the areas they accumulate in.

Symptoms vary depending on the type of tissue or organ affected. For example, if your gastrointestinal tract is affected you may experience stomach pain or diarrhoea. People with CEL may also have an enlarged liver or spleen.

The most commonly affected organ in CEL and HES is the heart. Inflammation and damage to the surrounding heart tissue can lead to a risk of clots or heart and valve dysfunction.

Other organs that can be affected by eosinophil infiltrates include the liver, nervous system, skin, lung, and kidneys.

## Diagnosis

CEL and HES is diagnosed through a process of elimination to exclude other causes of a raised eosinophil level. This may include tests such as blood tests and bone marrow examination, taking a stool and urine sample and x-rays.

### ***Blood tests***

CEL and HES is diagnosed through a blood test called a full blood count. In CES and HES elevated numbers of eosinophils are present. The mutation in the FIP1L1-PDGFR alpha gene can also be identified from a peripheral blood test.

### ***Bone marrow examination and gene mutation tests***

To confirm a diagnosis of CEL/HES your doctor may perform a bone marrow biopsy. The bone marrow will usually show a high number of immature and mature eosinophils. In advanced stages there may also be some scarring (fibrosis) in the bone marrow.

The FIP1L1-PDGFR fusion gene is present in some people with CEL/HES and is the most commonly identified mutation linked to the disease.

Under normal circumstances the PDGFRA gene makes a protein that is part of a family called the receptor tyrosine kinases. The PDGFRA protein plays a role in activating cell growth and survival. This is a tightly regulated process where the switch for cell growth is turned 'on' and 'off'.

When part of chromosome 4 is missing the PDGFRA gene can attach itself to another gene called the FIP1L1 gene. This creates the FIP1L1-PDGFRA fusion gene, which produces the FIP1L1-PDGFRA protein.

This abnormal protein functions in a similar way to the normal protein by flicking the 'on' switch and signalling cells to grow, but unlike the normal protein, the signal to stop cell growth is not switched 'off' and eosinophils are continuously produced.

## Treatment

CEL/HES may remain stable for many years, even decades, or it may quickly progress and transform to acute leukaemia. For this reason, the most appropriate treatment for each patient is decided on an individual basis.

Treatment may include corticosteroids, chemotherapy drugs such as hydroxyurea, and interferon therapy. Some people may respond to a drug called imatinib mesylate (Glivec®), commonly used in the treatment of another type of MPN called chronic myeloid leukaemia. A stem cell transplant may also be considered in some cases.

# Chronic neutrophilic leukaemia (CNL)

*In chronic neutrophilic leukaemia, too many neutrophils are made in the bone marrow. Neutrophils are very important in the body's immune defence against infection.*

Under normal circumstances neutrophils are the first white blood cells to respond to an area of infection or inflammation. Neutrophils move from the blood to the area of tissue injury and release their contents, which comprise of anti-bacterial proteins.

They also ingest dead or dying bacteria in the surrounding area and help to remove them. Finally they send out chemical signals, which attract more immune cells to the area.

The neutrophils are a major component of the pus present in wounds and are also responsible for the key signs of infection such as redness, heat, pain and swelling.

As such your doctor may need to rule out other causes of a raised neutrophil count before making a diagnosis of CNL, such as infection, inflammation, an allergic type reaction and other types of blood cancers.

CNL is a monoclonal (derive from a single stem cell) bone marrow disorder which results in an abnormal overproduction of neutrophils. These cells spill out into the circulating blood and tend to accumulate in the liver and spleen, which become enlarged as a result.

Some patients may carry mutations in some genes, including: CSF3R, SETBP1 and the SRC and JAK2 (V617F) genes. However, these mutations are not specific to CNL alone.

CNL is a very rare chronic disease diagnosed in an estimated two people in Australia each year. Most commonly people who are diagnosed are over 60 years of age. Although rare, CNL can occur at any age, including in children. It occurs more commonly in males than females.

## Symptoms

Symptoms can vary and largely depend on the phase of CNL and level of organ or tissue infiltration of neutrophils. There are three phases of CNL: chronic; accelerated; and blast phase.

Some people with CNL may not have any symptoms initially. Symptoms commonly experienced are general in nature and may include: weight loss, fatigue, loss of appetite and itching. Some people may develop an enlarged liver or spleen.

In more advanced phases of the disease people may experience symptoms related to low blood cell levels, such as shortness of breath or weakness related to anaemia, or easy bruising and bleeding related to low platelets (blood clotting cells). Very rarely, people experience enlarged lymph nodes.

## Diagnosis

CNL is diagnosed through a process of elimination to exclude other causes of a raised neutrophil level. This may include tests such as blood tests and a bone marrow examination, taking a stool and urine sample, x-rays, and other tests to look for the presence of infection or other cancers.

### ***Full blood count***

This disorder is diagnosed through a blood test called a full blood count showing elevated numbers of peripheral blood leukocytes (white blood cells) with more than 80% of these being neutrophils.

### ***Bone marrow examination and gene mutation tests***

To confirm a diagnosis of CNL your doctor may perform a bone marrow biopsy. The bone marrow will usually show a high number of cells, with a large proportion being immature and mature neutrophils.

The genetic mutations commonly found in CNL play a role in cell growth and development. When there are mutations in these genes a switch is flicked 'on' and the cell is signaled to continuously produce neutrophils.

Under normal circumstances, the signal for the body to produce more neutrophils occurs when a hormone made in the bone marrow interacts with the GCSF receptor on the cell surface.

This interaction triggers a response inside the white blood cell where two proteins, JAK2 and SRC, become activated or 'turned on'. These proteins then signal the cell to make more neutrophils.

Recently a mutation of the GCSF receptor has been found in patients with CNL and is thought to play a role in the development of CNL. The mutation in the GCSF receptor causes it to behave as if the hormone GCSF is present when it is not. This results in an overproduction of neutrophils, far in excess of what the body requires.

## Treatment

Chronic neutrophilic leukaemia is usually a slowly progressing disease. Its prognosis can vary considerably between individuals. There are no standard treatment protocols for CNL.

In the chronic phase the disease is progressing slowly. Blood counts remain relatively stable and the number of blast cells in the bone marrow and blood are low (<5%).

Medications are usually given to try and keep the disease in the chronic phase. These may include chemotherapy in the form of tablets (hydroxyurea). Other medications such as interferon may also be given.

If the disease is not controlled it may move into a more unstable phase known as the accelerated phase. In this phase the disease starts to progress more rapidly. Blood cells start to appear more abnormal and there are an increased number of blast cells found in the bone marrow and circulating blood.

The third phase of CNL is called the blast phase or blast crisis. In this phase the disease is uncontrolled and is rapidly progressing into a disease resembling an acute leukaemia. In blast phase, there are usually more than 20% blast cells in the blood and bone marrow.

People usually experience more severe symptoms of their disease during this phase. Normal blood cell production is impaired and a severe shortage of normal blood cells leads to an increased susceptibility to bleeding, infections and anaemia. Blast cells may accumulate in various parts of the body such as the spleen (which can become rapidly enlarged), the lymph nodes, skin and the central nervous system (brain and spinal cord).

Treatment during the accelerated and blast phase of the disease is usually more intensive and aimed at restabilising the chronic phase, and treating the symptoms of your disease.

Your medications may be increased or your doctor may recommend more intensive treatment such as a single (such as busulphan) or combination chemotherapy, administered by a drip directly into your vein.

A bone marrow transplant is the only known treatment option that offers the potential for a cure. This may be offered during the chronic phase of the disease.

# Systemic mastocytosis

*Normally, mast cells (a type of white blood cell), play a role in the body's immune reactions, such as allergy, allergic shock (called anaphylaxis), wound healing, and as a defence against invading foreign pathogens such as bacteria.*

Systemic mastocytosis is a monoclonal stem cell disorder (the disorder arises from a clone of identical faulty stem cells) that results in the overproduction of mast cells. These are produced in the bone marrow and accumulate in the bones, lymph nodes, liver, spleen, gastrointestinal tract, skin and other body tissues.

There are a number of subtypes of mastocytosis, but aggressive systemic mastocytosis is the only form that is recognised as a myeloproliferative neoplasm by the World Health Organisation. Aggressive systemic mastocytosis will be the focus of the information provided in this booklet and will now be referred to just as systemic mastocytosis (SM).

SM most commonly occurs in the adult population and can develop after an indolent (slow developing) form of the disease. It is a rare chronic disease diagnosed in an estimated 16 people in Australia each year.

Systemic mastocytosis is very rarely diagnosed in children.

## Symptoms

Symptoms occur as a result of mast cells releasing their contents (called degranulation) into surrounding tissues and organs. The type and severity of symptoms experienced by people affected by SM depends on the location of the mast cells within their body and how quickly the mast cells release their contents (called magnitude of release).

People affected by SM experience generalised symptoms such as weight loss, bone pain, itching and night sweats.

Some people experience symptoms associated with the mast cells slowly 'leaking' their contents steadily over time, while others experience symptoms associated with a rapid and sudden release of mast cell contents. Others experience both types of mast cell rates of degranulation.

The challenges faced by people living with SM are the unpredictable nature in which the mast cell contents are released and the subsequent unpredictability of symptoms people experience.

Excess numbers of mast cells release large amounts of histamine, heparin, leukotrienes and other substances that can cause allergic type reactions in affected tissues. For example, when these substances collect in the skin they tend to cause an itchy hive-like rash (called urticaria pigmentosa).

Allergic type symptoms associated with SM include abdominal pain, fainting, flushing, food sensitivity, nausea, diarrhoea and peptic ulcer disease (ulcers in the stomach and first part of the small intestine).

People also experience more severe and potentially life threatening symptoms such as difficulty breathing, heart dysfunction, altered consciousness and anaphylaxis.

## Diagnosis

A diagnosis of SM is made after a combination of a physical examination which may show an enlarged liver or spleen, blood tests and a bone marrow biopsy.

Systemic mastocytosis is diagnosed when there is involvement of mast cell infiltration in other tissues and organs and not just the skin.

### **Full blood count**

Some people with SM have a lower than normal number of blood cells in their peripheral blood such as red cells, platelets and white cells.

It is common for people with systemic mastocytosis have a raised blood tryptase level (>20ng/ml). Tryptase is a naturally occurring enzyme found in mast cells and plays a role in the body's immune responses such as allergic and more severe anaphylactic reactions.

Tryptase leaks out of the mast cells and into the circulating blood and tissues and is used as a marker to assist in the diagnosis of the disease. Tryptase levels can be elevated in other conditions and is why it is used to assist in the diagnosis of systemic mastocytosis and is not used as a definitive marker on its own.



### ***Bone marrow examination and gene mutation tests***

In SM, the bone marrow may contain dense infiltrates of mast cells which are found in groups of 15 or more. These groups of mast cells are not only found in the bone marrow but may also be found in extra-cutaneous tissue around the body.

The appearance of the mast cells may look abnormal or 'spindle shaped' under the microscope. There may even be a large amount of immature mast cells present in the tissues.

A mutation in the c-Kit gene (codon 816 and most commonly D816V mutation) is found in over 90% of people with SM. The c-kit gene mutation results in the activation and overproduction of mast cells by bone marrow stem cells.

### ***Urine test***

People may be asked to do a 24 hour urine collection to assist in the diagnosis of mastocytosis. This urine test measures the amount of histamine in a person's urine. Histamine is released from mast cells and is usually elevated in people with mastocytosis.

## **Treatment**

Treatment decisions tend to be made on an individual basis. Treatment for SM has a twofold approach: controlling the symptoms of the disease by targeting the mast cell contents that are released from the cells; and reducing the number of mast cells in the body.

Medications known as antihistamines or steroids are used to prevent and reduce allergic reactions. Other medications include mast cell stabilisers, leukotriene inhibitors and medications to reduce the risk of developing stomach ulcers.

Some people may require therapies such as chemotherapy or interferon to help control the overproduction of mast cells in the bone marrow.

People with SM may have reduced bone density resulting in osteoporosis and other bone abnormalities due to mast cell infiltration. Here, medications to reduce bone destruction, known as bisphosphonates may also be used.

People who have severe allergic type

reactions may need to carry an Epi-pen which contains a drug known as epinephrine. Epinephrine (also known as adrenaline) is used to reduce the body's immune response to severe allergic reactions. Before going to the hospital's emergency department, a person with SM may need to administer the epinephrine medication themselves, when they feel they are about to have a severe allergic type response.

## Complementary therapies

Complementary therapies are therapies that are not considered standard medical therapies. Many people, however, find that they may be helpful in coping with their treatment and recovery from disease. There are many different types of complementary therapies. These include yoga, exercise, meditation, prayer, acupuncture and relaxation.

Complementary therapies should 'complement' or assist with recommended medical treatment for myeloproliferative neoplasms. They should not be used as an alternative to medical treatment for an MPN. It is important to realise that no complementary or alternative treatment alone has proven to be effective against an MPN.

## Nutrition

A healthy and nutritious diet is important in helping your body to cope with your disease and treatment. Talk to your doctor or nurse if you have any questions about your diet or if you are considering making any radical changes to the way you eat. You may wish to see an accredited practising dietitian (APD) who can advise you on planning a balanced and nutritious diet suitable for your individual health needs and lifestyle.

If you are thinking about using herbs or vitamins it is very important to talk this over with your doctor or dietitian first. Some of these substances can interfere with the effectiveness of chemotherapy or other treatments you are having.

## *Making treatment decisions*

Many people feel overwhelmed when they are diagnosed with a myeloproliferative neoplasm. In addition to this, waiting for test results and then having to make decisions about proceeding with the recommended treatment can be very stressful.

Some people do not feel that they have enough information to make decisions while others feel overwhelmed by the amount of information they are given, or that they are being rushed into making a decision. It is important that you feel you have enough information about your illness and all of the treatment options available, so that you can make your own decisions about which treatment to have.

Sometimes it is hard to remember everything the doctor has said. It helps to bring a family member or a friend along who can write down the answers to your questions, prompt you to ask other questions, be an extra set of ears or simply be there to support you.

Before going to see your doctor make a list of the questions you want to ask. It is handy to keep a notebook or some paper and a pen handy as many questions are thought of in the early hours of the morning.

Your treating doctor will spend time discussing with you and your family what he or she feels is the best option for you. Feel free to ask as many questions as you need to, at any stage. You are involved in making important decisions regarding your wellbeing. You should feel that you have enough information to do this and that the decisions made are in your best interests. Remember, you can always request a second opinion if you feel that this is necessary.

## Clinical trials

Clinical trials (also called research studies) test new treatments or 'existing' treatments given in new ways to see if they work better. Clinical trials are important because they provide vital information about how to improve treatment by achieving better results with fewer side effects. In addition, clinical trials often give people access to new therapies that are not yet funded by governments.

If you are considering taking part in a clinical trial, make sure that you understand the reasons for the trial and what it involves for you. You also need to understand the benefits and risks of the trial before you can give informed consent. Talk to your doctor, as they can guide you in making the best decision for you.

## *Informed consent*

Giving an informed consent means that you understand and accept the risks and benefits of a proposed procedure or treatment. It means that you are happy that you have adequate information to make such a decision.

Your informed consent is also required if you agree to take part in a clinical trial or if information is being collected about you or some aspect of your care (data collection).

If you have any doubts or questions regarding any proposed procedure or treatment please do not hesitate to ask for more information from your doctor.

## *Information and support*

People cope with a diagnosis of an MPN in different ways, and there is no right, wrong or standard reaction. For some people the diagnosis can trigger any number of emotional responses ranging from denial to devastation. It is not uncommon to feel angry, helpless and confused. Naturally people fear for their own lives or that of loved ones.

It is worth remembering that information can often help to take away the fear of the unknown. It is best for people to speak directly to their doctor regarding any questions they might have about their disease or treatment. It can also be helpful to talk to other health professionals including social workers or nurses who have been specially educated to take care of people with blood and bone marrow diseases.

Diagnosis of an MPN can cause stress and anxiety for the effected persons' spouse or children. It may be helpful to talk with a psychologist about ways to help cope with feelings of worry and anxiety. Some people find it useful to talk with other patients and family members who understand the complexity of feelings and the kinds of issues that come up for people living with an illness of this nature and their families.

**If you have a psychological or psychiatric condition, please inform your doctor and don't hesitate to request additional support from a mental health professional.**

Many people are concerned about the social and financial impact of their diagnosis and treatment on their families. Normal family routines are often disrupted and other members of the family may suddenly have to fulfil roles they are not familiar with, for example cooking, cleaning, doing the banking and taking care of children.

There are a variety of programs designed to help ease the emotional and financial strain created by blood cancers and related disorders. The Leukaemia Foundation is there to provide you and your family with information and support to help you cope during this time. Contact details for the Leukaemia Foundation are provided on the back of this booklet.

# Useful internet addresses

## **Leukaemia Foundation**

[www.leukaemia.org.au](http://www.leukaemia.org.au)

## **Leukaemia Foundation of Queensland**

[www.leukaemiaqld.org.au](http://www.leukaemiaqld.org.au)

## **American Cancer Society**

[www.cancer.org](http://www.cancer.org)

## **Australian Bone Marrow Donor Registry**

[www.abmdr.org.au](http://www.abmdr.org.au)

## **Australian Mastocytosis Society (TAMS)**

[www.mastocytosisaustralasia.com](http://www.mastocytosisaustralasia.com)

## **Cancer Council of Australia**

[www.cancer.org.au](http://www.cancer.org.au)

## **Leukemia & Lymphoma Society (USA)**

[www.lls.org](http://www.lls.org)

## **Leukaemia & Lymphoma Research Fund (UK)**

[www.bloodwise.org.uk](http://www.bloodwise.org.uk)

## **Look Good ... Feel Better program**

[www.lgfb.org.au](http://www.lgfb.org.au)

## **MacMillan Cancer Support**

[www.macmillan.org.uk](http://www.macmillan.org.uk)

## **MPN Research Foundation (USA)**

[www.mpnresearchfoundation.org](http://www.mpnresearchfoundation.org)

## **National Cancer Institute (USA)**

[www.cancer.gov/about-cancer](http://www.cancer.gov/about-cancer)

## **The Myeloproliferative Disorders Research Consortium (USA)**

[www.mpdrc.org](http://www.mpdrc.org)

## **MPN Education Foundation**

[www.mpninfo.org](http://www.mpninfo.org)



# Glossary of terms

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## **Acute leukaemias**

Rapidly progressing cancers of the blood and bone marrow, usually of sudden onset and characterised by uncontrolled growth of immature blood cells which crowd the bone marrow and spill out into the bloodstream.

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## **Acute myeloid leukaemia (AML)**

A rapidly progressing cancer of the blood and bone marrow. AML affects developing blood cells on the myeloid cell line, usually white blood cells. It is more common in adults than in children.

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## **Allogeneic stem cell transplant**

The transplant of blood stem cells from one person to another. The donor is usually a sister or brother or an unrelated volunteer donor.

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## **Alopecia**

Hair loss. This is a side-effect of some kinds of chemotherapy and radiotherapy. It is usually temporary.

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## **Anaemia**

A reduction in haemoglobin in the blood. Haemoglobin normally carries oxygen to all of the body's tissues. Anaemia causes tiredness, paleness and sometimes shortness of breath.

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## **Antibiotic**

A drug used to prevent or treat bacterial infections.

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## **Antibodies**

Naturally produced substances in the blood, made by white blood cells called B-lymphocytes or B-cells. Antibodies target antigens on other substances such as bacteria, viruses and some cancer cells and cause their destruction.

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## **Antiemetic**

A drug which prevents or reduces feelings of sickness (nausea) and vomiting.

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## **Anti-fungal**

A drug used to prevent or treat fungal infections.

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## **Antigen**

A substance, usually on the surface of a foreign body such as a virus or bacteria that stimulates the cells of the body's immune system to react against it by producing antibodies.

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## **Antihistamine**

A drug used to prevent or reduce allergic reactions.

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## **Anti-viral**

A drug used to prevent or treat viral infections.

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## **Blast cells**

Immature blood cells normally found in the bone marrow. Blast cells normally constitute up to 5 per cent of all bone marrow cells. These cells divide and replenish all the normal blood cells in the marrow and circulating blood. Acute leukaemia is characterised by an accumulation of abnormal blast cells that take over the marrow and spill out into the blood stream.

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## **Blood cells**

There are three main types of cells. Red blood cells carry oxygen, white blood cells fight infection, and platelets help prevent bleeding. Normal numbers of each cell type must be maintained for the body to remain healthy.

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## **Blood count**

Also called a full blood count (FBC). A routine blood test that measures the number and type of cells circulating in the blood.

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## **Blood stem cells**

Primitive blood-forming cells that normally live in the bone marrow. They divide and mature into all the different types of blood cells (red cells, white cells and platelets), including the cells of our immune system.

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## **B-cell**

A type of white cell normally involved in the production of antibodies to combat infection.

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## **Bone marrow**

The tissue found at the centre of many flat or big bones of the body. Active or red bone marrow contains stem cells from which all blood cells are made and in the adult this is found mainly in the bones making up the axial skeleton – hips, ribs, spine, skull and breastbone (sternum). The other bones contain inactive or (yellow) fatty marrow, which, as its name suggests, consists mostly of fat cells.

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## **Bone marrow aspirate**

A procedure that involves removing a small sample of bone marrow fluid for examination in the laboratory. The fluid is drawn, under local or general anaesthetic, usually from the back of the hip, or occasionally from the breastbone.

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## **Bone marrow biopsy**

A procedure that involves removing a small core of bone marrow for examination in the laboratory. The biopsy (or trephine) is taken under local or general anaesthetic, from the back of the hip. It is usually done at the same time as the bone marrow aspirate.

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## **Bone marrow transplant**

See stem cell transplant.

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## Cancer

A malignant disease characterised by uncontrolled growth, division, accumulation, and invasion into other tissues of abnormal cells from the original site where the cancer started. Cancer cells can grow and multiply to the extent that they eventually form a lump or swelling. This is a mass of cancer cells known as a tumour. Not all tumours are due to cancer; in which case they are referred to as non-malignant or benign tumours.

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## Cannula

A plastic tube which can be inserted into a vein to allow fluid to enter the blood stream.

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## Central venous catheter (CVC)

Also known as a central venous access device (CVAD). A line tube passed through the large veins of the neck, chest or groin and into the central blood circulation. It can be used for taking samples of blood and giving intravenous fluids, blood, chemotherapy and other drugs without the need for repeated needles.

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## Chemotherapy

Single drugs or combinations of drugs which may be used to kill and prevent the growth and division of cancer cells. Although aimed at cancer cells, chemotherapy can also affect rapidly dividing normal cells and this is responsible for some common side-effects including hair loss and a sore mouth.

Nausea and vomiting are also common, but nowadays largely preventable with modern anti-nausea medication. Most side-effects of chemotherapy are temporary and reversible.

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## Chromosomes

Chromosomes are made up of coils of DNA (deoxyribonucleic acid). DNA carries all the genetic information for the body in sequences known as genes. There are approximately 40,000 genes on 23 different chromosomes. The chromosomes are contained within the nucleus of a cell.

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## Chronic leukaemias

A group of cancers that affect the blood and bone marrow. Chronic leukaemias usually develop gradually and slowly progress, particularly in the early stages of disease. The leukaemia is called chronic because the leukaemic cells are more mature than those found in acute leukaemia. Chronic leukaemias are sometimes diagnosed by chance, during a routine blood test.

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## Chronic myeloid leukaemia (CML)

A type of leukaemia which is an initially slow growing (indolent) disease where the bone marrow produces too many white cells. Over time, CML rarely transforms into acute leukaemia, a more aggressive type of disease where the bone marrow produces large numbers of abnormal immature granulocytes, known as blast cells or leukaemic blasts. CML is also called chronic myelogenous or chronic granulocytic leukaemia (CGL).

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## Clone

A population of genetically identical cells arising from a single parent cell.

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## Clotting factors

A group of naturally occurring substances found in the blood (factors I to XIII) which, when activated, interact to help blood clot and prevent bleeding.

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## Coagulation

Clotting of the blood. A complex process involving the interaction of a series of biochemical components and blood cells known as platelets.

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## Computerised axial tomography (CT scan or CAT scan)

A specialised x-ray or imaging technique that produces a series of detailed three dimensional (3D) images of cross sections of the body.

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## Corticosteroids (steroids)

A group of man-made hormones including prednisone, prednisolone, methylprednisolone and dexamethasone used in the treatment of certain blood and bone marrow cancers. As well as having anti-cancer effects, corticosteroids also have anti-inflammatory and immunosuppressive (anti-rejection) effects.

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## Cytogenetic tests

The study of the genetic make-up of the cells, in other words, the structure and number of chromosomes present. Cytogenetic tests are commonly carried out on samples of blood and bone marrow to detect chromosomal abnormalities associated with disease. This information helps in the diagnosis and selection of the most appropriate treatment.

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## Cytokines

See growth factors.

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## Cytopenia

A reduction in the number of blood cells circulating in the bloodstream.

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## Disease progression

This means that the disease is getting worse despite treatment.

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## Echocardiogram

A special ultrasound scan of the heart.

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## Electrocardiogram (ECG)

Electrical trace of the heart.

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## Essential thrombocythemia

A condition caused by abnormal bone marrow growth (myeloproliferative disease). It is characterised by the production of large numbers of platelets. Symptoms include bleeding, blood clots and enlargement of the spleen.

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## Growth factors

A complex family of proteins produced by the body to control the growth, division and maturation of blood cells by the bone marrow. Some are now available as drugs as a result of genetic engineering and may be used to stimulate normal blood cell production following chemotherapy or bone marrow or peripheral blood cell transplantation. For example G-CSF (granulocyte colony stimulating factor).

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## Haematologist

A doctor who specialises in the diagnosis and treatment of diseases of the blood, bone marrow and immune system.

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## Haemoglobin

The iron containing pigment in red blood cells, which carries oxygen to all the body's tissues.

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## Haemopoiesis

The formation of blood cells.

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## Immune system

The body's defense system against infection and disease.

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## Immunocompromised

When the function of the immune system is reduced

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## Immunophenotyping

Specialised laboratory tests used to detect markers on the surface of cells. These markers identify the origin of the cell.

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## Immunosuppression

The use of drugs to reduce the function of the immune system.

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## Leukaemia

A cancer of the blood and bone marrow characterised by the widespread, uncontrolled production of large numbers of abnormal and/or immature blood cells. These cells take over the bone marrow often causing a fall in blood counts. If they spill out into the bloodstream however they can cause very high abnormal white cell counts.

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## Leukaemic blasts

Abnormal immature blood cells that multiply in an uncontrolled manner, crowding out the bone marrow and preventing it from producing normal blood cells. These abnormal cells also spill out into the blood stream and can accumulate in other organs.

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## Lymph nodes or glands

Structures found throughout the body, for example in the neck, groin, armpit, chest and abdomen, which contain both mature and immature lymphocytes. There are millions of very small lymph glands in all organs of the body.

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## Lymphocytes

Specialised white cells that help defend the body against disease and infection. There are two types of lymphocytes: B-lymphocytes and T-lymphocytes. They are also called B-cells and T-cells.

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## Lymphoid

Term used to describe a pathway of maturation of blood cells in the bone marrow. White blood cells (B-lymphocytes and T-lymphocytes) are derived from the lymphoid stem cell line.

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## Malignancy

A term applied to tumours characterised by uncontrolled growth and division of cells (see cancer).

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## Matched (volunteer) unrelated donor (MUD) transplant

An allogeneic stem cell transplant where the donor is unrelated to the patient, but has a similarly matched tissue type. Also called voluntary unrelated donor (VUD) transplant.

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## Mucositis

An inflammation of the lining of the mouth, throat or gut.

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## Mutation

A change in the DNA code of a cell, caused for example by exposure to hazardous chemicals or copying errors during cell division. If mutations affect normal cell function this can lead to the development of disease due to the loss of normal function or the development of abnormal functions of that cell.

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## Myeloid

Term used to describe a pathway of maturation of blood cells in the bone marrow. Red cells, white cells (neutrophils, eosinophils, basophils and monocytes) and platelets are derived from the myeloid stem cell line.

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## Myelodysplastic disorders

Also known as myelodysplastic syndromes (MDS). These are a group of blood diseases that affect normal blood cell production in the bone marrow. In MDS, the bone marrow produces too few red cells, white cells and platelets, and an excess of immature blood cells known as blast cells.

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## Myelofibrosis

A disorder in which the bone marrow becomes replaced by fibrous tissue and is unable to produce adequate numbers of blood cells.

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## Myeloproliferative neoplasms

A group of disorders characterised by the over-production of blood cells by the bone marrow. One or more of the cell families (red, white, platelets or support tissue), may be involved and treatment varies depending on the type and severity of the disease. Includes chronic myeloid leukaemia, polycythemia rubra vera, essential thrombocythemia and idiopathic myelofibrosis.

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**Neoplasm (or clonal disorder).**

A disease where there is an abnormal growth of cells arising from a single mutant cell.

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**Neutropenia**

A reduction in the number of circulating neutrophils, an important type of white cell. Neutropenia is associated with an increased risk of infection.

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**Neutrophils**

Neutrophils are the most common type of white cell. They are needed to mount an effective fight against infection, especially bacteria and fungi.

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**Pathologist**

A doctor who specialises in the laboratory diagnosis of disease and how disease is affecting the organs of the body.

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**Petechiae**

Red or purple flat pinhead sized spots on the skin, especially on the legs. They are caused by tiny bleeds under the skin, usually as a result of a severe shortage of platelets.

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**PICC line**

Peripherally inserted central venous catheter (see central venous catheter). It is inserted in the middle of the forearm. PICCs are sometimes used for people having chemotherapy.

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**Platelets**

Tiny disc-like fragments that circulate in the blood and play an important role in clot formation.

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**Promary myelofibrosis**

A type of myeloproliferative neoplasm in which bone marrow tissue is replaced with abnormal fibrous tissue and is unable to produce adequate numbers of blood cells.

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**Prognosis**

An estimate of the likely course of a disease.

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**Purpura**

Purple spots on the skin, often accompanied by bleeding from the gums. It is caused by a shortage of platelets as well as fragile skin.

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**Radiotherapy (radiation therapy)**

The use of high energy x-rays to kill cancer cells and shrink tumours.

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**Relapse**

The return of the original disease.

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**Remission**

When there is no evidence of disease detectable in the body. This is not the same as a cure as relapse may still occur.

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### **Resistant or refractory disease**

This means that the disease is not responding to treatment.

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### **Spleen**

An organ that accumulates lymphocytes, acts as a reservoir for red cells for emergencies, and destroys blood cells at the end of their lifespan.

The spleen is found high in the abdomen on the left-hand side. It cannot normally be felt on examination unless it is enlarged. It is often enlarged in diseases of the blood or bone marrow – this is known as hypersplenism or splenomegaly.

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### **Splenomegaly**

Another term used to describe an enlarged spleen.

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### **Stable disease**

When the disease is stable it is not getting any worse or any better with treatment.

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### **Standard therapy**

The most effective and safest therapy currently being used.

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### **Stem cells**

Stem cells are primitive blood cells that can give rise to more than one cell type. There are many different types of stem cells in the body. Bone marrow (blood) stem cells have the ability to grow and produce all the different blood cells including red cells, white cells and platelets.

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### **Stem cell transplant**

General name given to bone marrow and peripheral blood stem cell transplants.

These treatments are used to support the use of high-dose chemotherapy and/or radiotherapy in the treatment of a wide range of cancers including leukaemia, lymphoma, myeloma and other serious diseases.

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### **Thrombocytopenia**

A reduction in the number of circulating platelets. Thrombocytopenia is associated with an increased risk of bleeding and bruising.

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### **T-cell**

A type of white cell involved in controlling immune reactions.

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### **Ultrasound**

Pictures of the body's internal organs built up from the interpretation of reflected sound waves.

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### **White cells**

Specialised blood cells of the immune system that protect the body against infection. There are five main types of white cells: neutrophils, eosinophils, basophils, monocytes and lymphocytes.







# Making a donation



The Leukaemia Foundation is the only national not-for-profit organisation dedicated to the care and cure of patients and families living with leukaemia, lymphoma, myeloma and related blood disorders. The Foundation receives no ongoing government support and relies on the generosity of the community to support our Vision to Cure and Mission to Care.

## How can I give?



**ONLINE** [www.leukaemia.org.au](http://www.leukaemia.org.au)



**PHONE** 1800 620 420



**POST** (complete this form or enclose cheque/money order and return)

The Leukaemia Foundation, Reply Paid 9954 in your capital city

Name	
Address	
Postcode	
Phone	Mobile
Email	

I enclose my gift of (please tick box)

\$30  \$50  \$75  \$100  \$250 Other \$

I wish to make a regular monthly donation of \$

Commencing on

/ / \*

\*You can cancel at any time by calling 1800 620 420.

My cheque/money order made payable to the Leukaemia Foundation is enclosed.

I wish to pay with my credit card and my details are included below:

Visa  MasterCard  Diners  Amex

Card Number

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Expiry Date	/	CVV
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Cardholder's Name
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Signature
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Your privacy is important to us. That is why we treat your personal information with confidence. To learn more about how and why we collect and use any personal or sensitive information about you, please view our Notification Statement at [www.leukaemia.org.au/privacy](http://www.leukaemia.org.au/privacy)



## Please send me a copy of the following booklets:

Leukaemia, Lymphoma, Myeloma, MDS, MPN and related blood disorders

Acute Lymphoblastic Leukaemia in Adults (ALL)

Acute Lymphoblastic Leukaemia in Children (ALL)

Acute Myeloid Leukaemia (AML)

Amyloidosis

Chronic Lymphocytic Leukaemia (CLL)

Chronic Myeloid Leukaemia (CML)

Hodgkin Lymphoma

Non-Hodgkin Lymphoma (NHL)

Myelodysplastic Syndrome (MDS)

Myeloma

Myeloproliferative Neoplasms (MPN)

Eating Well

Living with Leukaemia, Lymphoma, Myeloma, MDS, MPN and related blood disorders

Allogeneic Stem Cell Transplants (also called Bone Marrow Transplants)

Autologous Stem Cell Transplants

Young Adults with a Blood Cancer

My Haematology Diary

### Books for children:

Tom has Lymphoma

Joe has Leukaemia

Ben's Stem Cell Transplant

Jess' Stem Cell Donation

### Or information about:

The Leukaemia Foundation's Support Services

Giving at work

Monthly giving program

National fundraising campaigns

Volunteering

Receiving our newsletters

Leaving a gift in my will

Name

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Address

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Postcode

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Phone  Mobile

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Email

**POST TO** The Leukaemia Foundation, Reply Paid 9954 in your capital city

**PHONE** 1800 620 420 **EMAIL** info@leukaemia.org.au

**FURTHER INFORMATION ONLINE** www.leukaemia.org.au



This information booklet is produced by the Leukaemia Foundation and is one in a series on leukaemia, lymphoma, myeloma, MDS, MPN and related blood disorders.

Copies of this booklet can be obtained from the Leukaemia Foundation in your state by contacting us.

The Leukaemia Foundation is a not-for-profit organisation that depends on donations and support from the community. Please support our work.

*July 2015*

## *Contact us*



1800 620 420



GPO Box 9954, IN YOUR CAPITAL CITY



[info@leukaemia.org.au](mailto:info@leukaemia.org.au)



[leukaemia.org.au](http://leukaemia.org.au)



Leukaemia  
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VISION TO CURE  
MISSION TO CARE