Myeloproliferative Disorders

A guide for patients, families and whānau
The Leukaemia & Blood Foundation is grateful to Infinity Foundation Limited for sponsoring this booklet
Myeloproliferative Disorders

a guide for patients, families and whānau

The term ‘Myeloproliferative Disorders’ is the general name given to a group of blood conditions. The following are discussed in this booklet:

- Polycythaemia vera (PV)
- Essential thrombocythaemia (ET)
- Primary myelofibrosis (PMF)
- Chronic eosinophilic leukaemia (CEL)
- Chronic neutrophilic leukaemia (CNL)
- Mastocytosis

There is a separate booklet entitled ‘Chronic Myeloid Leukaemia – a guide for patients, families and whanāu’ available from the Leukaemia & Blood Foundation.
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This booklet has been written to help you and your family and whānau to understand more about a group of conditions known as myeloproliferative disorders.

If you or a loved one have been diagnosed with a myeloproliferative disorder, you may be feeling anxious or a little overwhelmed. 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.

This booklet is not designed to be read from cover to cover, some of the sections cover different diseases and it may be more useful to look at the list of contents and read the parts that you think will be of most relevance for you.

We have used some medical words and terms that you may not be familiar with. Their meaning is either explained in the text, in the 'Dictionary of Terms' booklet or in the glossary of terms at the back of this booklet.

In some parts of the booklet we have provided additional information you may wish to read on selected topics. This information is presented in shaded boxes. Some people may require more information than is contained in this booklet; we have included a list of internet addresses that you might find useful. In addition, you may receive additional 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 specific circumstances at all times with your treating doctor.

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

**Acknowledgements**

The Leukaemia & Blood Foundation of New Zealand acknowledges the support of the Leukaemia Foundation of Australia for granting us permission to use some of the material within this booklet.

The Leukaemia & Blood Foundation gratefully acknowledges Dr David Simpson (North Shore Hospital) and Dr Peter Ganly (Christchurch Hospital) for assisting us with the development of this booklet.
THE LEUKAEMIA & BLOOD FOUNDATION

The Leukaemia & Blood Foundation (LBF) is the only organisation in New Zealand dedicated to supporting patients and their families living with leukaemia, lymphoma, myeloma and related blood conditions.

Since 1977, our work has been made possible through our fundraising events and the generous support we receive from individuals, companies, trusts and grants. We do not receive government funding.

LBF manages the New Zealand Bone Marrow Donor Registry, which works towards finding a matched volunteer donor from New Zealand or overseas for patients who need a bone marrow or stem cell transplant, and who do not have a family donor. The registry maintains information on New Zealand donors and has access to our worldwide database of over ten million donors.

VISION TO CURE - MISSION TO CARE

Within our vision to cure and mission to care the Leukaemia & Blood Foundation provides:

**Patient Support**

The Leukaemia & Blood Foundation’s Patient Support Service provides personalised support programmes for patients and their families. This can include regular visits, phone or email contact, as well as face to face education & support programmes and an online information forum. We also provide a toll free number for advice, empathy and support.

**Education and Information**

We provide vital information to patients, families, health professionals and the community to improve understanding about blood cancers and conditions.

**Research**

Supporting and funding investigation into blood cancers and conditions. Research plays a critical role in bringing further understanding and better treatment to patients which in turn leads to improvement in survival rates.
Advocacy

Representing the needs of the patients and their families to the Government, related agencies and other relevant agencies.

Awareness

Increasing public knowledge about leukaemia, lymphoma and related blood conditions.

Contacting us

The LBF provides services and support throughout New Zealand. Every person’s experience of living with blood cancers and conditions is different. Living with leukaemia, lymphoma, myeloma, or a related blood condition is not easy, but you don’t have to do it alone.

Please freephone 0800 15 10 15 to speak to a local Support Services staff member or to find out more about the services offered by the Leukaemia & Blood Foundation. Alternatively, contact us via email by sending a message to lbf@leukaemia.org.nz or by visiting www.leukamia.org.nz.

We are pleased to welcome personal visitors to our national office located at 6 Claude Road, Epsom, Auckland.
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. In infants, haematopoiesis takes place inside all bones. In adults, not as much marrow is needed, so the marrow in some bones turns to fat and active marrow. Active marrow is limited to the more central bones of the body, the hips, ribs, spine, skull and breastbone (sternum). Some of you may have had a bone marrow biopsy taken from the back of your hip (the posterior iliac crest), or less commonly, the breastbone (sternum).

You might like to think of the bone marrow as the blood cell factory. The three main types of cells in the blood are red cells, white cells and platelets, and these are all made in the bone marrow. The blood cells all start their life as stem cells. They are few in number but when stimulated are able not only to divide to replicate themselves, but also to grow and divide into more mature stem cells, called myeloid stem cells and lymphoid stem cells. These cells multiply and mature further to produce all the circulating blood cells.

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

**Lymphoid** (‘lim-oid’) stem cells develop into two other types of white cells called T-lymphocytes and B-lymphocytes.
Growth factors and cytokines

All normal blood cells have a limited survival in the circulation and need to be replaced on a continual basis. This means that the bone marrow remains a very active tissue throughout your life. Natural chemicals in your blood called growth factors or cytokines control the process of blood cell formation. Different growth factors stimulate the blood stem cells in the bone marrow to produce different types of blood cells.

Some growth factors can now be made in the laboratory and are available for use in people with blood disorders. For example, granulocyte-colony stimulating factor (G-CSF) stimulates the production of white cells called neutrophils while erythropoietin (EPO) stimulates the production of red cells. Thrombopoietin (TPO) stimulates platelet production. Although copies of the natural product cause problems, drugs that mimic its function (e.g. Eltrombopag) can be used to increase platelet numbers.

Blood

Circulating blood consists of blood cells and plasma. Plasma is the straw coloured fluid that blood cells are suspended in as they travel around your body.

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. Haemoglobin also carries carbon dioxide to the lungs where it can be breathed out.

| The normal haemoglobin range for a man is between 130 - 170 g/L |
| The normal haemoglobin range for a woman is between 120 - 160 g/L |

Red cells are by far the most numerous blood cell and the proportion of the blood that is occupied by blood cells is called the haematocrit or PCV (Packed Cell Volume). A low haematocrit suggests that the number of red cells in the blood is lower than normal.

| The normal range of the haematocrit for a man is between 40 - 52% |
| The normal range of the haematocrit for a woman is between 36 - 46% |
Anaemia is a condition caused by a reduction in the number of red cells, which in turn results in a low haemoglobin level. Measuring the haemoglobin will provide information regarding the degree of anaemia.

If you are anaemic you may feel run down 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 red cell transfusion may be given to restore the red cell numbers and thereby increase the haemoglobin to more normal levels.

**WHITE CELLS**

White cells, also known as leucocytes, fight infection. There are two main types of white cells that fight infection together and in different ways.

White cells are commonly divided into two main groups: granulocytes and agranulocytes. Granulocytes (neutrophils, eosinophils and basophils) are so named because they contain microscopic granules capable of digesting micro-organisms. Agranulocytes (lymphocytes and monocytes) are white cells which do not contain granules.

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The normal adult white cell count is between $4.0 - 11.0 \times 10^9/L$

If your white cell count drops below normal you are at risk of infection.
Neutropenia is the term given to describe a lower than normal neutrophil count. If you have a neutrophil count of less than 1.0 (1.0 x 10^9/L) you are considered to be moderately neutropenic, and at risk of developing frequent and sometimes severe infections.

The normal adult neutrophil count is between 2.0 – 7.5 x 10^9/L

PLATELETS

Platelets are disc-shaped cellular fragments that circulate in the blood and play an important role in clot formation. They help to prevent bleeding in two main ways. Firstly, if a blood vessel is damaged (e.g. by a cut) the platelets gather at the site of injury, stick together and form a plug to help stop the bleeding. Their second function is to carry clotting components and release them in high concentrations at the site of damage.

The normal adult platelet count is between 150 - 400 x 10^9/L

Thrombocytopenia is the term used to describe a reduction in the platelet count to below normal. If your platelet count is low you are at a higher risk of bleeding, and tend to bruise easily. Platelet transfusions are sometimes given to bring the platelet count back to a higher level, aiming for >20 (20 x 10^9/L).

The normal reference ranges for blood counts provided here may differ slightly from the ones used at your treatment centre. You can ask for a copy of your blood results, which should include the normal values for each blood cell type.

Children

In children, some normal blood cell counts vary with age. If your child is being treated for a myeloproliferative disorder you can ask your doctor or nurse for a copy of their blood results, which should include the normal values for each blood type for a male or female child of the same age.

WHICH DOCTOR?

If your GP suspects that you might have a myeloproliferative disorder, you will be referred to another specialist doctor (called a haematologist) for further tests and treatment. A haematologist is a doctor who specialises in the care of people with diseases of the blood, bone marrow and immune system.
What is a myeloproliferative disorder?

Myeloproliferative disorders is the general name given to a group of conditions where there is an overgrowth of cells in the bone marrow, often leading to increased numbers of cells in the blood. The name comes for the Greek word for bone marrow - “myelo”, and “proliferative” because there is an overgrowth of the cells there. Myeloproliferative disorders are a clonal overgrowth of blood cells.

In myeloproliferative disorders the cells in the bone marrow multiply in an uncontrolled way. In contrast with leukaemia, where there is an overgrowth of immature cells. In myeloproliferative disorders the cells mature with normal function, there are just too many of them.

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

Types of myeloproliferative disorders

Myeloproliferative disorders are described according to the type of blood cell which is most affected. There are 4 main types of myeloproliferative disorders that together represent around 95 per cent of all cases:

1. **Polycythaemia vera** (PV) – too many red cells
2. **Essential thrombocythaemia** (ET) – too many platelets
3. **Primary myelofibrosis** (PMF) – bone marrow tissue is replaced by fibrous scar-like tissue, disrupting normal blood cell production.
4. **Chronic myeloid leukaemia** (CML) - too many neutrophils

There is a separate booklet called ‘Chronic Myeloid Leukaemia – a guide for patients and families’ available from the Leukaemia & Blood Foundation.

Myeloproliferative disorders are closely related diseases, so it’s not uncommon for people to have features of more than one myeloproliferative disorder when they are first diagnosed, or during the course of their illness. In some cases, one disorder may transform over time to another, or to a type of leukaemia called acute myeloid leukaemia.
Uncommon types of myeloproliferative disorders together make up about 5% of cases. These include:

- **Chronic neutrophilic leukaemia (CNL)** – too many neutrophils
- **Chronic eosinophilic leukaemia (CEL)/hypereosinophilic syndrome** - too many eosinophils
- **Mastocytosis** – too many mast cells
- **Myeloproliferative disease, unclassifiable**

**WHAT CAUSES MYELOPROLIFERATIVE DISORDERS?**

The cause of myeloproliferative disorders remains unknown, although there is now rapidly increasing knowledge of some of the changes that trigger the disease. Myeloproliferative disorders are sometimes described as being clonal blood stem cell disorders. This means that they result from a change, or mutation, in the DNA of a single blood stem cell. This change (or changes) results in abnormal blood cell development, and in this case, the overproduction of blood cells.

In myeloproliferative disorders 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 defect. Mutations in dividing cells occur all the time and cells have sophisticated mechanisms within them to stop these abnormalities persisting.

The longer we live, the more chance we have of acquiring mutations that escape these safeguards. That’s why myeloproliferative disorders can become more common as we get older.

A mutation of a particular gene (a segment of DNA) known as Janus kinase 2 (JAK 2) is found in a large proportion of people with myeloproliferative disorders. The discovery of a mutation in the JAK2 gene is important because it is has had a significant impact on the way myeloproliferative disorders are diagnosed and may be important for treatment in the future.

Finally, myeloproliferative disorders are not contagious; you cannot ‘catch’ these disorders by being in contact with someone who has one. Most people with a myeloproliferative disorder have no family history of the disease.
POLYCYTHAEMIA VERA (PV)

Polycythaemia vera (previously known as polycythaemia rubra vera) is a disease in which there are more red cells in the blood than normal. Because of this, the blood thickens, and doesn’t flow easily.

What causes polycythaemia vera?

Normally the number of red cells in the blood is controlled by the growth factor erythropoietin (EPO). When there are not enough red cells, erythropoietin is released from the kidneys, where it is made. As the number of red cells increases, the erythropoietin level falls and red cell production slows. In polycythaemia vera the red cells grow even when EPO levels are low. The reason for this was discovered in 2005 when it was found that most patients with polycythaemia vera had an abnormal or mutant JAK2 protein. JAK2 is part of the signal used by EPO to make the red cells grow. The mutant JAK2 causes the red cells to grow whether EPO is present or not.

Many people who are diagnosed with PV ask “why me?”. Naturally, they want to know what has happened or what they might have done to cause their condition. The truth is that no one knows exactly what causes PV. We know that polycythaemia vera is an acquired bone marrow disorder that is not inherited - not passed down from one generation to the next.

Most people with polycythaemia vera have a distinctive genetic abnormality in their JAK2 protein. JAK2 is a type of protein called a tyrosine kinase. This protein is used by many receptors including those for erythropoietin, thrombopoietin and granulocyte colony-stimulating factor (G-CSF - a growth factor for white cells). These receptors normally become active when the growth factor binds the receptor on the surface of the cell.

In patients with polycythaemia vera the JAK2 protein is always active. In most cases this is caused by a single change in the genetic code called V617F. This mutation means that the JAK2 signal is always switched on. Although the main abnormality is the overgrowth of red blood cells, there is also an over growth in white cells and platelets. A smaller number of patients have a mutation in a different part of the protein called exon 12. If this is the case the red blood cells alone, not the white cells or platelets, are increased.
Symptoms and complications of polycythaemia vera

Many people have no symptoms when they are first diagnosed with polycythaemia vera and the disease is picked up accidentally during a routine blood test or physical examination. In other cases, people go to see their GP because they are experiencing symptoms of their disease.

When symptoms do occur, they develop gradually over time. They are mainly due to the increased thickness (hyperviscosity) of the blood, the increased blood volume and slower blood flow. Common symptoms include: headaches, blurred vision, tiredness, fatigue, weakness, dizziness, chest pain, itchiness (especially after a hot bath), and night sweats.

Enlargement of the spleen (splenomegaly) is also common and occurs in around 75 per cent of cases. 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. This is also called hepatomegaly.

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 increased skin temperature that may be episodic or almost continuous in nature.

In many cases, people with polycythaemia vera 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. A raised blood pressure (hypertension) is also common.
BLOOD CLOTS (THROMBOSIS) AND BLEEDING

Because the blood is thicker than normal 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 deep and superficial veins of the legs, in the heart (causing a myocardial infarction or heart attack) and in the brain (causing a stroke).

Blood clots are a common complication of polycythaemia vera and occur in around 30 per cent of patients. Sometimes blood clots occur before a diagnosis of polycythaemia vera is made. Older people and those with a history of a previous blood clot are at increased risk. A major aim of treatment in polycythaemia vera is to maintain a normal blood count, and reduce the 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.

**How is polycythaemia vera diagnosed?**

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

**FULL BLOOD COUNT**

People with polycythaemia vera have a high red cell count with a correspondingly high haemoglobin level and haematocrit (proportion of red cells in their blood), due to the excessive production of red cells. A raised white cell count (especially a raised neutrophil count) and a raised platelet count are also common findings.

In most patients the diagnosis is confirmed by testing for the JAK2 mutation. The JAK2 testing is done on a regular blood test and is positive in nearly all cases.

Another finding that helps confirm the diagnosis of polycythaemia vera is an enlarged spleen.

**RED CELL MASS**

Measurement of the total red cell mass was previously necessary for making a diagnosis of polycythaemia vera. However, with the availability of the test for JAK2 mutation in most cases it is no longer needed. Polycythaemia vera is diagnosed when the red cell mass is 25% greater than the average normal expected value. This test is now mainly used when the haemoglobin is high and the JAK2 mutation is negative.
Measuring your red cell mass

The blood test that measures your red cell mass may take a couple of hours to complete. It involves taking a sample of your blood from a vein in your hand or arm, mixing it with a special substance called an isotope, and re-injecting it back into your bloodstream. After this more blood tests are taken over the next hour to measure the dilution of the isotope and thus your red cell mass, then comparing it to expected normal values.

BONE MARROW EXAMINATION

A bone marrow biopsy is not always necessary in patients with polycythaemia vera. However, when performed, the bone marrow is abnormal with increased numbers of normal cells. Fibrosis or scarring of the bone marrow may be prominent, especially if the disease has been present for a number of years. Iron stores measured in the bone marrow may be depleted since iron is being used to make more and more red cells, and iron absorption is reduced.

Bone marrow aspirate and biopsy

A procedure that involves removing some marrow for examination in the laboratory. The biopsy (or trephine) is small core of bone is taken under local or occasionally general anaesthetic, from the back of the hip. A sample of bone marrow and soft inner bone is withdrawn or aspirated for testing under a microscope.

OTHER TESTS THAT MAY BE PERFORMED:

Blood tests:
- serum vitamin B-12 levels - which can be high
- uric acid levels - high
- erythropoietin levels - low
- coagulation studies - to see if your blood is clotting normally
- blood oxygen levels - usually normal but if the oxygen is low it points to a cause other than PV for the high haemoglobin

Other examinations:
- Chest x-ray – to rule out lung disease
- Abdominal ultrasound or CT scan - to rule out kidney disease and measure spleen and liver size.
How is polycythaemia vera treated?

The goal of treatment for polycythaemia vera is to reduce the number of cells in the blood and help to maintain a normal blood count. This helps control any symptoms of hyperviscosity (thick blood) and reduces the risk of blood clots, 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 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 polycythaemia vera because it can help to rapidly reduce a high red cell count. In a process similar to a blood donation, 450-500mls of your blood is removed, usually from a large vein in front of your elbow. This is usually done in the outpatient department of the hospital and takes about 30 minutes to complete. You will need to have a blood test before venesection to check your blood count, and 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. 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 PV, regular venesection (every few months) may be all that is needed to control their disease for many years. After a while most patients receiving regular venesections are iron deficient, but as there is no anaemia they do not feel tired.

It is important not to take iron supplements as this will cause the haemoglobin level to rise rapidly and cause the symptoms of polycythaemia vera to return.

Many people with polycythaemia vera also need other treatments in addition to (or instead of) venesection to help control their blood count.
CHEMOTHERAPY

Myelosuppressive (bone marrow suppressing) drugs are commonly used to reduce blood cell production in the bone marrow. These drugs are commonly used for people with a high platelet count, 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 myelosuppressive agent is a chemotherapy drug called hydroxyurea. It is particularly useful in controlling a high platelet count (thrombocytosis) in older patients and therefore reducing the risk of thrombosis. Hydroxyurea is taken in capsule form at home every day. As hydroxyurea is a chemotherapy drug, it can affect your fertility. If this could be an issue for you, please ask your haematologist about the options available.

Most people who take hydroxyurea have very few side effects but a small number of people do not tolerate it well. Sometimes they feel dizzy or just not right, these symptoms may go away with time but you should discuss any side effects with your haematologist. Hydroxyurea can also increase the number of minor skin cancers in people with sun damaged skin. This is usually a minor effect but can be a problem in some people.

Rarely, people taking hydroxyurea can develop ulcers around their ankles. If these develop, please discuss this with your haematologist.

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

There is a very small risk of developing leukaemia later on in people who receive chemotherapy for prolonged periods of time. This risk is very small, perhaps non-existent, for people receiving hydroxyurea and must be weighed against the potentially serious complications of uncontrolled disease.

INTERFERON

Interferon is a substance produced naturally by the body’s immune system. It plays an important role in fighting disease. In polycythaemia vera, synthetic 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 using a very small needle. You or a family member (or friend) will be taught how to do this at home. A weekly injection is also now available and is becoming more widely used.

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, aches and pains and weakness. Your doctor or nurse will explain any side effects you may experience while you are having these treatments and how they can be managed.
ASPIRIN

Aspirin has been shown to significantly reduce the risk of thrombosis in people with polycythaemia vera. It is usually given to all patients with polycythaemia vera unless there is a reason not to give it.

Aspirin works by preventing your platelets from clumping together to form harmful blood clots in different parts of your body. Aspirin can irritate the lining of the stomach which can result in pain or discomfort in the stomach, causing nausea, heartburn or loss of appetite. Taking aspirin with food or milk may help prevent this. In addition, many people are prescribed enteric-coated aspirin that allows the drug to pass through the stomach and into the intestine before dissolving. This helps to reduce the risk of stomach upset.

ANAGRELIDE HYDROCHLORIDE

Anagrelide hydrochloride (anagrelide or Agyrlin®) is a drug used to reduce high platelet counts in people with polycythaemia vera and essential thrombocythaemia. However, studies have shown that hydroxyurea is more effective in most patients in reducing the risk of complications - thus anagrelide is used only in people who do not tolerate hydroxyurea.

Anagrelide affects platelet-producing cells in the bone marrow called megakaryocytes, slowing down platelet production and therefore reducing the number of platelets circulating in the 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 and can be taken with or without food. The capsule strength and the frequency you need to take anagrelide will depend on your platelet count, your response to treatment and how well the drug is tolerated.

Your doctor will keep track of your response to anagrelide and adjust your dose as required to maintain your platelet count at the desired level. Side effects are generally mild to moderate and may decrease with continued therapy. The most commonly reported side effects include headaches, fast or forceful heartbeat (palpitations), diarrhoea, weakness, fluid retention, nausea, dizziness, abdominal pain and shortness of breath.

It is important to report any side effects you are experiencing to your doctor as many of them can be treated to reduce any discomfort to you. You need to contact your doctor immediately if you experience the following symptoms: shortness of breath or any difficulty breathing, swollen ankles, fast, forceful or irregular heartbeat, and/or chest pain.

You should not stop taking anagrelide or any other medication for polycythaemia vera unless this has been discussed with your haematologist. Stopping these medications suddenly can be harmful.
BONE MARROW OR STEM CELL TRANSPLANTS

Bone marrow or stem cell transplants using a sibling or unrelated donor can be successful at curing patients with polycythaemia vera. They can be a good option for younger patients with advanced disease. However, transplant is not commonly recommended and the decision to proceed to transplant needs to be considered very carefully. There are considerable side effects from the treatment and in some cases there can be complications that may be fatal.

There are separate booklets about Stem Cell Transplants available from the Leukaemia & Blood Foundation.

Prognosis

The natural course of polycythaemia vera can vary considerably between individuals. In most patients, with treatment, the disease remains stable for long periods of time - often many decades. Around one third of all people with polycythaemia vera will develop increasing fibrosis of their bone marrow (myelofibrosis). When this occurs the spleen may become increasingly enlarged. Anaemia and thrombocytopenia are 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.

At present, treatment of these complications is supportive - to try to improve the patient’s quality of life by relieving any symptoms they might have and by preventing and treating any complications that arise from their disease or its treatment. This may involve giving iron tablets, blood transfusions if required, pain relief and medications to try and suppress the active bone marrow.

In selected cases, splenectomy (surgical removal of the spleen) or low dose radiotherapy to the spleen may be required to relieve symptoms. In younger patients a bone marrow or stem cell transplant may be a treatment option. In the future, drugs that block the JAK2 mutation may be used - these are currently in development.

Your haematologist 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. However, in essential thrombocythaemia, the 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, essential thrombocythaemia is an uncommon chronic disease diagnosed in an estimated 3 cases per 100,000 people each year. Although it can occur at any age, even (rarely) in children, essential thrombocythaemia usually affects older people, with most patients diagnosed between the ages of 50 and 70 years. It occurs equally in both males and females.

Symptoms and complications of essential thrombocythaemia

Many people have no symptoms when they are first diagnosed with essential thrombocythaemia and their disease is picked up incidentally during a routine blood test. If symptoms do occur they may include tingling or burning in the hand and feet, headache, visual problems, weakness and dizziness. These, and other symptoms result from excessive numbers of platelets reducing blood flow in small or large blood vessels in different parts of the body, or due to clotting factors being released from the platelets.

People who are prone to migraines can suffer from these more often if they have ET, as serotonin (a hormone), which is a cause of the migraine, is released by platelets. Migraines are usually improved by taking aspirin, and reducing the platelet count (see treatment of essential thrombocythaemia).

BLOOD CLOTS (THROMBOSIS) AND BLEEDING

Thrombosis is the major complication of essential thrombocythaemia. Older patients, those with a very high platelet count, or a prior history of thrombosis, are at increased risk. A major aim of treatment in essential thrombocythaemia is to reduce your platelet count, and with it your risk of thrombosis.

Platelets are important in the formation of blood clots in the fast flowing arteries. Blood clots can occur in large or small arteries interfering with the blood (and therefore oxygen) supply to various organs or tissues. Blockages in the smaller blood vessels in the fingers and toes can cause redness of the skin and burning and throbbing pains. These pains are often made worse by heat or exercise and can be relieved by cooling and elevating the affected area. These symptoms are often dramatically improved using small daily doses of aspirin, and/or reducing the 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. Blood clots can also develop in the veins of the legs (causing deep vein thrombosis) and, less commonly, the spleen and liver restricting the blood flow and causing pain in these organs. A blood clot that breaks off the wall of the vein and travels in the blood stream is known as an embolism. When a blood clot travels to the lungs it is known as a pulmonary embolism and can cause serious breathing problems.

Less commonly, patients with essential thrombocythaemia can experience symptoms of abnormal bleeding. This can include bruising for no apparent reason, 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.

In pregnancy, uncontrolled essential thrombocythaemia can reduce the blood supply to the placenta or fetus. This can cause problems with fetal growth and may in some cases may lead to pregnancy loss.

**How is essential thrombocythaemia diagnosed?**

The diagnosis of essential thrombocythaemia is made only 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 essential thrombocythaemia. Under the microscope the platelets may be abnormally large. Fragments of megakaryocytes, the cells from which platelets are released, may also be seen in the blood film. Around a third of people with essential thrombocythaemia will also have a mildly raised red cell and/or white cell count.

If the results of your blood test suggest that you may have essential thrombocythaemia, further investigation and tests may be required to help confirm the diagnosis and rule out other secondary or ‘reactive’ causes of a raised platelet count.

**JAK2 AND OTHER MUTATIONS (see WHAT CAUSES MYELOPROLIFERATIVE DISORDERS?)**

A mutant form of JAK2 can be found in about 50% of patients with essential thrombocythaemia. This is the same mutation found in most people with polycythaemia vera. About 5% of patients with ET have a mutation in a different gene, the MPL receptor - which is the receptor or thrombopearin (TPP) the growth factor for platelets.

The result of these changes is that platelet production continues even when the body has too many platelets. Testing for these mutations can be useful for confirming a diagnosis, but they do not rule out a diagnosis of essential thrombocytopsis if they are negative. These tests can be done on a blood sample.
BONE MARROW EXAMINATION

In essential thrombocythaemia the bone marrow is usually found to be overactive, similar to polycythaemia vera. An excess number of abnormal megakaryocytes is a common finding. Cytogenetic and molecular analysis of blood and bone marrow cells may be carried out in the laboratory to help confirm the diagnosis.

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

How is essential thrombocythaemia treated?

The goal of treatment for people with essential thrombocythaemia is to prevent complications such as abnormal clotting, bleeding and bruising. It is quite likely that you may not have any symptoms of essential thrombocythaemia when you are first diagnosed. Some patients do not require any treatment for many years. Instead your doctor may recommend a ‘watch and wait’ strategy which 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 that increase your chances of developing a blood clot. You may be advised about ways to help you maintain a healthy weight and blood pressure, and to stop smoking.

Most people with essential thrombocythaemia will require some form of treatment to reduce their platelet count and therefore reduce their risk of thrombosis. The treatment chosen will depend on a number of factors that influence your particular risk of complications due to thrombosis or bleeding. These include 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 the risk of thrombosis. These factors are among those taken into account when planning the most appropriate treatment for your disease.

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

Anagrelide hydrochloride (anagrelide or Agyrin®) and interferon (see treatment of polycythaemia vera) may also be used. Studies have shown that hydroxyurea is better at reducing complications than anagrelide and is usually preferred.

Those people at low-risk may be treated using low dose aspirin, or an equivalent drug alone. They usually have a very good outlook with no difference compared with the general population.

Your haematologist will be able to discuss all of the treatment options suitable for you.
PLATELETHERESIS

Very rarely, if your platelet count is very high and you have symptoms of clotting or bleeding, your platelet count will need to be reduced quickly to prevent further complications. In these emergency situations, excess platelets can be removed from your bloodstream using a procedure known as plateletpheresis. During this procedure a portion of your blood is passed through a special machine called a cell separator. The blood is drawn from a cannula (plastic needle) placed in a vein in one arm. The machine spins the blood very quickly and removes the excess platelets. This is a continuous process. While platelets are being removed the rest of your blood is being returned to you via another cannula, placed in your other arm.

Plateletpheresis is usually carried out in hospital. It usually takes about two hours to complete.

Prognosis

Essential thrombocythaemia is regarded as an incurable disease, but, in many people the disease remains stable for long periods of time, often decades, with treatment. In the longer term, a small number of people with essential thrombocythaemia may develop scarring of the bone marrow called myelofibrosis. The risk of ET transforming to acute myeloid leukaemia is relatively low (1–2%).

Your haematologist 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 (also called idiopathic myelofibrosis or agnogenic myeloid metaplasia) 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 reticulin fibres on which the stem cells can divide and grow. Specialised cells in the bone marrow known as fibroblasts make these fibres. In primary 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.

Primary myelofibrosis is a rare chronic disorder diagnosed in an estimated 1 person per 100,000 each year. It can occur at any age but is usually diagnosed later in life, between the ages of 60 and 70 years. In about 50% of cases there is a mutation in the JAK2 gene (see polycythaemia vera above). JAK2 is a protein that is responsible for sending a growth signal to the cell when the cell is stimulated by a growth factor, such as erythropoietin, or thromboietin. Another mutation is found in the MPL receptor in about 10% of cases.

In myelofibrosis there is excessive growth of bone marrow cells. While several different types of bone marrow cells grow abnormally the fibrosis is most likely caused by the overstimulation of the megakaryocytes that make platelets. Around one third of people with myelofibrosis have been previously diagnosed with polycythaemia vera or essential thrombocythaemia. Long-term exposure to high levels of benzene or very high doses of ionising radiation may increase the risk of primary myelofibrosis but this accounts for only a small number of cases.

Symptoms and complications of primary myelofibrosis

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 or physical examination if the spleen is enlarged. For others, symptoms develop gradually over time. Symptoms of anaemia are common and include unexplained tiredness, weakness, shortness of breath and palpitations. Other non-specific symptoms include fever, unintentional weight loss, pruritis (generalized itching) and excess sweating, especially at night.
Almost all patients with primary myelofibrosis have an enlarged spleen (splenomegaly) when they are first diagnosed. In around one third of cases the spleen is very enlarged. Common symptoms of an enlarged spleen include feelings of discomfort, pain or fullness in the upper left-side of the abdomen. An enlarged spleen may also cause pressure on your stomach causing a feeling of fullness, indigestion and a loss of appetite. Abdominal discomfort can also result from an enlarged liver (hepatomegaly), which occurs in around two-thirds of cases.

Other less common symptoms include bone and joint pain, and bleeding problems.

**How is primary myelofibrosis diagnosed?**

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. Primary myelofibrosis is only diagnosed when other causes of marrow fibrosis (including leukaemia and lymphoma) have been ruled out.

**FULL BLOOD COUNT**

People with primary myelofibrosis often have varying degrees of anaemia when diagnosed. When examined under the microscope the red cells are often described as being ‘teardrop-shaped’. 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 not always possible to obtain any samples of bone marrow fluid using a needle and syringe (bone marrow aspiration) due to the marrow fibrosis. This is known as a ‘dry tap’. The bone marrow trephine biopsy typically shows abnormal fibrosis of the marrow cavity.

Cytogenetic and molecular analysis of blood and bone marrow cells is also carried out under the microscope to help confirm the diagnosis.
How is primary myelofibrosis treated?

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

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

A chemotherapy drug such as hydroxyurea (see treatment of polycythaemia vera) may be used to reduce an enlarged spleen. In some cases, the surgical removal of the spleen (called a splenectomy) may be considered, especially if 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. It is less helpful for those who have low platelet counts. Small doses of radiotherapy to the spleen can also be given to reduce its size. This usually provides temporary relief for about 3 to 6 months.

Bone marrow or stem cell transplants using a sibling or unrelated donor can be successful at curing patients with myelofibrosis. They can be a good option for younger patients with advanced disease. However, transplant is not commonly recommended and the decision to proceed to transplant needs to be considered very carefully. There are considerable side effects from the treatment and in some cases there can be complications that may be fatal.

There are separate booklets about Stem Cell Transplants available from the Leukaemia & Blood Foundation.

Although they are not yet available, drugs that target the mutant JAK2 protein are being developed and these may prove useful in the future.
Blood and platelet transfusions

If symptoms of anaemia are interfering with your normal daily activities, your doctor may recommend that you have a red blood cell transfusion. Platelet transfusions are sometimes given to prevent or treat bleeding (for example, a persistent nose bleed) when the platelet count is below a critical level.

You do not need to be admitted to hospital for a red blood cell or platelet transfusion and 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 shivery or in any way unwell during the transfusion, as this might indicate that you are having a reaction. Steps can be taken to minimize these symptoms and ensure that they don’t happen again.

Prognosis

Primary myelofibrosis, in most people, is an incurable disease. However, many people can remain comfortable and symptom-free for many years, even without treatment.

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, primary myelofibrosis progresses more quickly and people require treatment to help relieve symptoms of their disease. Transformation to acute myeloid leukaemia occurs in between 10 and 20% of cases.

Your haematologist 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) / HYPEREOSINOPHILIC SYNDROME

Chronic eosinophilic leukaemia (also known as hypereosinophilic syndrome) is a rare myeloproliferative disorder in which too many eosinophils (a type of white blood cell) are made in the bone marrow. These cells spill out of the bone marrow and accumulate in the blood and other tissues around the body.

Symptoms and complications of chronic eosinophilic leukaemia

Some people with chronic eosinophilic leukaemia 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, pruritis (generalized itching) or diarrhoea. Sometimes there can be chronic changes to the lungs with increased lung fibrosis, which can make you short of breath on exertion. Sometimes the heart muscle can be affected by fibrosis. This makes the heart muscle stiff and less able to pump blood effectively. The heart valves can develop fibrin deposits which can cause the heart valves to leak and this can be heard as a heart murmur.

How is chronic eosinophilic leukaemia diagnosed?

This is often a difficult diagnosis to make. While a simple blood test will demonstrate that high numbers of eosinophils are present, it is often difficult to find out what the cause of this is. Eosinophils are increased in the blood in allergic reactions, in response to some infections (such as intestinal worms), related to abnormal lymphocytes, or due to a myeloproliferative disorder.

In some people mutations that affect the growth of eosinophils can be detected by a blood test. These tests may help in deciding the best treatment to give.

Mutations in CEL

There has been increasing knowledge of how CEL develops in some people. Three types of mutations have been described:

• those that affect the platelet derived growth factor receptor (PDGFR). These can involve either the alpha (PDGFRα) or beta (PDGFRβ) chain that makes up the complete receptor.

• Mutations of the fibroblast growth factor receptor (FGFR1).

Finding mutations can be useful for diagnosis as they are not found in reactive eosinophilia states. The presence of mutations can also predict the response to treatment.
Treatment and prognosis of chronic eosinophilic leukaemia

The natural course of chronic eosinophilic leukaemia can vary considerably between individuals. The disease may remain stable for many years, even decades, or it may quickly progress and transform to an acute leukaemia. Because of this, the most appropriate treatment for each patient is decided upon on an individual basis. Treatment may include corticosteroids, chemotherapy drugs such as hydroxyurea, and interferon therapy (see treatment of polycythaemia vera). Some patients may respond to a newer drug called imatinib mesylate, most often used in the treatment of chronic myeloid leukaemia. A stem cell transplant may be considered in selected cases.

CHRONIC NEUTROPHILIC LEUKAEMIA

Chronic neutrophilic leukaemia is another rare myeloproliferative disorder in which too many neutrophils are made in the bone marrow. These cells spill out into the circulating blood and tend to accumulate in the liver and spleen, which become enlarged as a result. Chronic neutrophilic leukaemia is usually a slowly progressing disease, closely related to another type of leukaemia called chronic myeloid leukaemia, but the cause and treatment are different. Its natural course can vary considerably between individuals with survival times ranging from 6 months to over 20 years. Treatment options may include the use of chemotherapy drugs such as busulphan or hydroxyurea, which are given in tablet or capsule form (see treatment of polycythaemia vera). These drugs are used to control the high white cell count.
MASTOCYTOSIS

Mastocytosis is a disorder that results from the overproduction of mast cells (a type of white blood cell), in the bone marrow. These cells accumulate in the blood, spleen, skin and other body tissues. Excess numbers of mast cells release large amounts of histamine and other substances which can cause allergic-type reactions in affected tissues. For example, when these substances collect in the skin they tend to cause an itchy rash. Other allergic-type symptoms may include abdominal pain and difficulty breathing. Medications called antihistamines are used to prevent and reduce allergic reactions.

There are two main types of mastocytosis:

There has been increasing knowledge of how CEL develops in some people. Three types of mutations have been described:

• Cutaneous mastocytosis. Only affecting the skin, this is most commonly seen in children, and has a good prognosis, often resolving at puberty.

• Systemic mastocytosis. More common in adults, this affects the bone marrow and other tissues, including the skin.

Finding mutations can be useful for diagnosis as they are not found in reactive eosinophilia states. The presence of mutations can also predict the response to treatment.

Symptoms and complications of mastocytosis

One feature of mast cell collections in the skin is that they release histamine when stroked. This causes a raised wheal to come up on the skin, called urticaria. This can be more pronounced in some people and can result in blisters forming, especially in children under the age of 3 years. In some people you can draw on the skin and raised lines appear, a symptom called dermatographism.

Symptoms from the mast cells can be grouped into 4 categories:

1. Constitutional symptoms, such as fatigue, weight loss, sweating and fevers.
2. Skin symptoms, including itch, urticaria and dermatographism.
3. Systemic symptoms related the release of mast cell granules, such as abdominal pain, flushing, fainting, headache, rapid pulse, cough and shortness of breath.
4. Musculoskeletal problems including bone pain, osteoporosis, fractures, joint and muscle aches.

Some people with mastocytosis may have an enlarged spleen, less commonly the lymph nodes are enlarged. Spleen and lymph node enlargement are more common if the disease is faster growing. Some people have abnormal mast cells circulating in the blood.
**Diagnosis and treatment of mastocytosis**

The diagnosis of mastocytosis can be made on skin or bone marrow biopsies, and by measuring the blood level of tryptase, an enzyme released by the mast cells. Treatment decisions tend to be made on an individual basis and may include chemotherapy in tablet form and/or interferon therapy (see *treatment of polycythaemia vera*) to help control the overproduction of mast cells in the bone marrow. Many cases of mastocytosis in adults have been shown to have a mutation of a protein called KIT, which is a growth factor for the cells that causes them to keep growing. New drugs that block this mutant protein are being developed and may prove useful for treating mastocytosis.
MAKING TREATMENT DECISIONS

Many people feel overwhelmed when they are diagnosed with a myeloproliferative disorder. 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 such 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.

**Standard therapy**

Standard therapy refers to a type of treatment which is commonly used in particular types and stages of disease. It has been tried and tested (in clinical trials) and has proven to be safe and effective in a given situation.

**Clinical trials**

These trials (also called research studies) test new treatments or ‘old’ treatments given in new ways to see if they might work better. Clinical trials are important because they provide vital information about how to improve treatment by achieving better results with fewer side effects. Clinical trials often give people access to new therapies 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 give your informed consent. Talk to your doctor who can guide you in making the best decision for you.

**Informed consent**

Giving your 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 talk to your haematologist or nurse again.
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 others, 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 haematologist 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 this is necessary.

COMPLEMENTARY THERAPIES

Complementary and alternative therapies are therapies which are not considered standard medical therapies. Many people however find that they are 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. They should not be used instead of standard medical treatment. It is important to realise that no complementary or alternative treatment alone has proven to be effective. It is also important that you inform your doctor if you are using any complementary therapies or alternative therapies in case they interact with your prescription medications.
**NUTRITION**

A healthy and nutritious diet is important in helping your body to cope with your disease and treatment. Talk to your doctor, nurse or dietician 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 a nutritionist or dietician who can advise you on planning a balanced and nutritious diet.

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

**BODY IMAGE, SEXUALITY AND SEXUAL ACTIVITY**

You may find that the diagnosis and treatment of a myeloproliferative disorder will have some impact on how you feel about yourself as a man or a woman and as a ‘sexual being’.

Patients with any disease including the myeloproliferative disorders may experience a decrease in libido, which is your body’s sexual urge or desire, sometimes without there being any obvious reason. It may take some time for things to return to ‘normal’. It is perfectly reasonable and safe to have sex while you are on treatment or shortly afterwards, but there are some precautions you need to take. It is usually recommended that you or your partner do not become pregnant as some of the treatments given might harm the developing baby. As such you need to ensure that you or your partner use a suitable form of contraception. Condoms (with a spermicidal gel) offer good contraceptive protection as well as protection against infection or irritation. Partners are sometimes afraid that sex might in some way harm the patient. This is not likely as long as the partner is free from any infections and the sex is relatively gentle. Finally, if you are experiencing vaginal dryness, a lubricant can be helpful. This will help prevent irritation.

If you have any questions or concerns regarding sexual activity and contraception don’t hesitate to discuss these with your doctor or nurse, or ask for a referral to a doctor or health professional who specialises in sexual issues.
INFORMATION AND SUPPORT

People cope with a diagnosis in different ways, and there is no right or 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 a loved one. On the other hand, people who don’t currently require treatment may wonder if they are sick at all.

It is worth remembering that information can often help to take away the fear of the unknown. It is best for you and your family to speak directly to your haematologist regarding any questions you 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 haematological diseases. Some people find it useful to talk with other patients and their 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.

In some areas there may be patient group meetings, and there is also an online support and information forum run by the Leukaemia & Blood Foundation – LifeBloodLIVE. This is available at www.lifebloodlive.org.nz.

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

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.

There are a variety of programmes designed to help ease the emotional and financial strain created by a diagnosis of a blood cancer or condition. Support Services staff at the Leukaemia & Blood Foundation are available to provide you and your family with information and support to help you cope during this time. Contact details for the Leukaemia & Blood Foundation are provided on the back of this booklet.
USEFUL INTERNET ADDRESSES

The value of the internet is widely recognised, however, not all the information available may be accurate and up to date. For this reason, we have selected some of the key sites that people with leukaemia might find useful.

With the exception of our own websites, the Leukaemia & Blood Foundation do not maintain these listed sites. We have only suggested sites we believe may offer credible and responsible information, but we cannot guarantee the information on them is correct, up to date or evidence based medical information.

**Leukaemia & Blood Foundation of New Zealand**

www.leukaemia.org.nz

www.lifebloodlive.org.nz

**Cancer Society of New Zealand**

www.cancernz.org.nz

**Leukaemia Foundation of Australia**

www.leukaemia.org.au

**MPD Foundation (USA)**

www.mpdfoundation.org

**MPD Support (UK)**

www.mpd-support.com

**National Cancer Institute (USA)**

www.cancer.gov/cancertopics/types/myeloproliferative

**CancerBACKUP (A UK cancer information site)**

www.cancerbackup.org.uk

**Leukemia & Lymphoma Society of America**

www.leukemia-lymphoma.org

**Leukaemia Research Fund (UK)**

www.lrf.org.uk
GLOSSARY OF TERMS

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. These include acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL).

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

Antiemetic
A drug used to prevent or reduce feelings of sickness (nausea) and vomiting.

Blasts
Abnormal immature blood cells that multiple in an uncontrolled manner, crowding out the bone marrow and preventing it from producing normal blood cells. These abnormal cells can also spill out into the bloodstream and accumulate in other organs. High numbers of blasts are present in acute leukaemias.

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

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 sternum.

Bone marrow aspirate
A procedure that involves removing (or aspirating) a small sample of bone marrow fluid for examination in the laboratory. The fluid is aspirated, under local or general anaesthetic, usually from the back of the pelvic bone, or occasionally from the breastbone (sternum).

Bone marrow biopsy
A procedure that involves removing a small core of bone and bone marrow for examination in the laboratory. The biopsy (or trephine) is taken under local or general anaesthetic, from the back of the pelvic bone.

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.

Cannula
A small plastic tube which can be inserted into a vein to allow fluid and medications to enter the bloodstream.
Chemotherapy
Single drugs or combinations of drugs which may be used to kill and prevent the growth and division of malignant cells. Although aimed at malignant 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 (mucositis). Nausea and vomiting are also common, but nowadays largely preventable with modern anti-nausea medication. Most side effects are temporary and reversible. Different combinations and different strengths of chemotherapy are used for a wide range of blood cancers and conditions. Treatment and it’s effects vary from person to person.

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.

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 leukaemia cells divide and increase in number more slowly than in acute leukaemia. Typically, chronic leukaemic cells are more mature than those found in acute leukaemia. Chronic leukaemias are sometimes diagnosed incidentally, during a routine blood test.

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. Overtime, CML can transform 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).

Clinical trial
A controlled and carefully monitored assessment of new forms of treatment. Trials can vary in design and size from small-scale trials of experimental treatments to large national trials that compare subtle variations in current therapies. The patient will be informed and will always be given the option not to join, or not without detriment to their treatment when their treatment is part of a trial. Likewise, patients can opt out of a clinical trial at any time.

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.

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.
DNA (Deoxyribonucleic acid)
Molecules found in the centre of the cell that carry all the genetic information for the body. There are four different chemical compounds of DNA (bases) arranged in coded sequences called genes, which determine an individual’s inherited characteristics.

Echocardiogram
A special ultrasound scan of the heart.

Electrocardiogram (ECG)
A recording of the electrical activity of the heart.

Full Blood count
Also called a Complete Blood Count (CBC). A routine blood test that measures the number and type of cells circulating in the blood.

Genes
Collections of DNA. Genes direct the activity of cells. They are responsible for the inherited characteristics that distinguish one individual from another. Each person has an estimated 100,000 separate genes.

Growth factors and cytokines
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 stem cell transplantation.

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

Haemopoiesis (or Haematopoiesis)
The processes involved in blood cell formation. In adults this occurs in the bone marrow.

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

High dose therapy
The use of higher than normal doses of chemotherapy to kill off resistant and/or residual (left over) cancer cells that have survived standard-dose therapy.

Imatinib mesylate (Glivec®)
A relatively new drug used to treat chronic myeloid leukaemia and other Philadelphia chromosome positive (Ph+) leukaemias. Imatinib is classified as a tyrosine kinase inhibitor. It works by targeting the abnormal BCR-ABL gene thereby blocking the leukaemia-causing effects of the enzyme tyrosine kinase. Also known as imatinib (Glivec®).

Immune system
The body’s defence system against infection and disease.

Immunocompromised
When someone has decreased immune function.
Leukaemia
A cancer of the blood and bone marrow characterised by the widespread, uncontrolled production of large numbers of abnormal 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.

Leucopheresis (leukopheresis)
A procedure that uses a special machine called a ‘cell separator’ to separate and remove white blood cells from the circulation before returning the remainder of the blood to the patient (see apheresis). Leucopheresis is the technique used to collect stem cells from the blood for use in a stem cell transplant. It is also sometimes used to reduce a dangerously high white cell count.

Lymph nodes or glands
Structures found throughout the body, for example in the neck, groin, armpit and abdomen, which contain both mature and immature lymphocytes. There are millions of very small lymph glands in all organs of the body. Their role is to filter the lymph fluid, which “washes” the tissues, and detect infection.

Lymphocytes
Specialised white blood cells involved in defending 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.

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.

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

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.

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.

Myeloproliferative disorders
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 (CML), polycythaemia vera (PV), essential thrombocythaemia (ET) and primary myelofibrosis.
**Neutropenia**
A reduction in the number of circulating neutrophils, an important type of white blood cell. Neutropenia is associated with an increased risk of infection.

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

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

**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.

**Philadelphia chromosome**
The abnormal chromosome present in nearly all cases of chronic myeloid leukaemia and some cases of acute lymphoblastic leukaemia. It is formed when part of chromosome 9 (the abl gene) breaks off and attaches itself to part of chromosome 22 (the bcr gene) in a process known as translocation.

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

**Prognosis**
An estimate of the likely course of a disease. It provides some guide regarding the chances of curing the disease or controlling it for a given time.

**Radiotherapy (radiation therapy)**
The use of high energy x-rays to kill cancer cells and shrink tumours.

**Resistant or Refractory Disease**
This means that the disease is not responding to treatment.

**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 – this is known as splenomegaly.

**Splenomegaly**
Another term used to describe an enlarged spleen.

**Standard therapy**
The most effective and safest therapy currently being used.

**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 cell in the body. Bone marrow stem cells have the ability to grow and produce all the different blood cells including red cells, white cells and platelets.
**Stem cell transplant**
General name given to bone marrow and peripheral blood stem cell transplants. Typically a transplant involves taking early blood/bone marrow cells from one person and giving them to another to restore normal bone marrow function in the recipient. 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.

**Translocation**
A chromosomal abnormality in which part of the one chromosome is transferred to another.

**T-lymphocyte**
A type of white cell involved in controlling immune reactions.

**Tumour**
An abnormal mass of cells which may be non-malignant (benign) or malignant (cancerous).

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

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

**X-ray**
A form of radiation used in diagnosis and treatment.

*Please refer to the Dictionary of Terms booklet for further definitions.*
Please send me a copy of the following patient information booklets:

- Living with a Blood Condition
- Acute Myeloid Leukaemia
- Chronic Myeloid Leukaemia
- Non-Hodgkin Lymphoma
- Myeloproliferative Disorders
- Multiple Myeloma
- Young Adults with a Blood Cancer
- Dictionary of Terms
- Acute Lymphoblastic Leukaemia
- Chronic Lymphocytic Leukaemia
- Hodgkin Lymphoma
- Myelodysplastic Syndromes
- Allogeneic Stem Cell Transplants
- Autologous Stem Cell Transplants

Or information on:

- The Leukaemia & Blood Foundation's Support Services
- How to make a bequest to the Leukaemia & Blood Foundation
- How to become a volunteer
- I would like to receive copies of the newsletter, LifeBlood

Name: ........................................................................................................................................
Address: ....................................................................................................................................
Postcode: ...................................................... Phone: .................................................................
Email: ...........................................................................................................................................

Send to: The Leukaemia & Blood Foundation
PO Box 99182 Newmarket, Auckland 1149.
Phone: (09) 638 3556 or 0800 15 10 15.
Email: lbf@leukaemia.org.nz

The Leukaemia & Blood Foundation will record your details to facilitate services and keep you informed about leukaemia and related blood disorders. We value your privacy and take all the necessary steps to protect it. You can access, change or delete this information by contacting us at lbf@leukaemia.org.nz.
## Contact details of Haematology Centres throughout NZ

<table>
<thead>
<tr>
<th>Centre</th>
<th>Address</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Whangarei Hospital</td>
<td>Hospital Road</td>
<td>(09) 430 4100</td>
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<td>Whangarei</td>
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<tr>
<td>North Shore Hospital</td>
<td>Shakespeare Road</td>
<td>(09) 486 1491</td>
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<td>Takapuna</td>
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<tr>
<td>Auckland Hospital</td>
<td>Park Road</td>
<td>(09) 379 7440</td>
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<td>Starship Hospital</td>
<td>Park Road</td>
<td>(09) 379 7440</td>
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<tr>
<td>Middlemore Hospital</td>
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<td>(09) 276 0000</td>
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<td>Otahuhu</td>
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<tr>
<td>Waikato Hospital</td>
<td>Pembroke Street</td>
<td>(09) 839 8899</td>
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<td>Thames Hospital</td>
<td>Mackay Street</td>
<td>(07) 868 6550</td>
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<td>Cameron Road</td>
<td>(07) 579 8000</td>
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<td>Hastings Hospital</td>
<td>Omahu Road</td>
<td>(06) 878 8109</td>
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<td>Rotorua Hospital</td>
<td>Pukeroa Street</td>
<td>(07) 348 1199</td>
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<td>Whakatane Hospital</td>
<td>Stewart Street</td>
<td>(07) 306 0999</td>
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<td>Palmerston North Hospital</td>
<td>Ruahine Street</td>
<td>(06) 356 9169</td>
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<td>Wellington Hospital</td>
<td>Riddiford Street</td>
<td>(04) 385 5999</td>
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<td>Christchurch Hospital</td>
<td>Riccarton Avenue</td>
<td>(03) 364 0640</td>
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<td>Dunedin Hospital</td>
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<tr>
<td>Invercargill Hospital</td>
<td>Kew Road</td>
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