Cancer Association of South Africa (CANSA)

Research • Educate • Support

Fact Sheet on Adult Chronic Myelomonocytic Leukaemia

Introduction

Chronic Myelomonocytic Leukaemia (CMML) is a form of chronic leukaemia characterised by high numbers of white blood cells called monocytes in the blood and bone marrow. It is sometimes classified as a form of myelodysplastic syndrome (MDS). Please refer to the Fact Sheet on Myelodysplastic Syndromes (MDS).

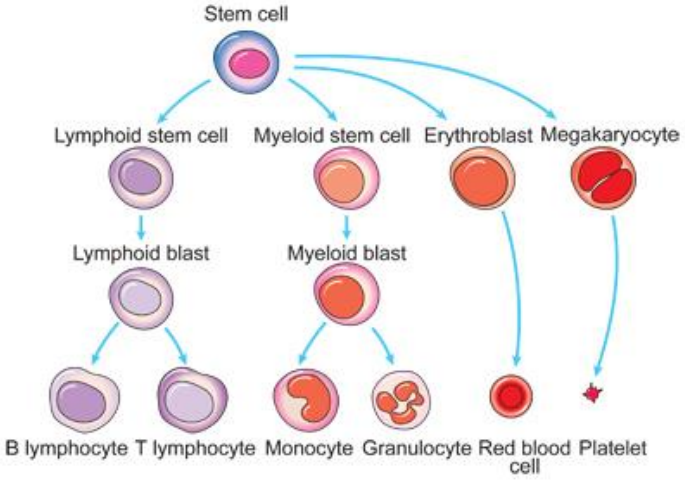


Diagram showing how blood cells are made
Copyright © Cancer Research UK

[Picture Credit: Blood Cells]

About half of all patients with CMML have a form in which there is a high white cell count at diagnosis and the condition behaves most like a myeloproliferative neoplasm (MPN). The other half of patients have a normal or reduced white cell count at diagnosis and the disease behaves more like a Meyelodysplastic syndrome (MDS). Men are more often affected than women.

It is mainly a disease of later life with the median age at onset being about 70 years. There is also a juvenile form known as Juvenile Myelomonocytic Leukaemia (JMML).
(Leukaemia & Lymphoma Research)

Incidence of Adult Chronic Myelomonocytic Leukaemia (CMML)

In providing the incidence figures of leukaemia in South Africa, The National Cancer Registry does not make provision for the reporting of the different types of leukaemia – it also does not differentiate between acute and chronic leukaemia - neither does it provide for different statistics for cases of adult and childhood leukaemia.

According to the National Cancer Registry (2011) the following number of Leukaemia cases was histologically diagnosed in South Africa during 2011:

Group - Males 2011	Actual No of Cases	Estimated Lifetime Risk	Percentage of All Cancers
All males	437	1:425	1,38%
Asian males	13	1:325	2,14%
Black males	231	1:633	2,36%
Coloured males	47	1:434	1,25%
White males	146	1:192	0,83%

Group - Females 2011	Actual No of Cases	Estimated Lifetime Risk	Percentage of All Cancers
All females	313	1:744	0,97%
Asian females	10	1:807	1,33%
Black females	161	1:1 203	1,15%
Coloured females	43	1:465	1,13%
White females	99	1:312	0,72%

The frequency of histologically diagnosed cases of Leukaemia in South Africa for 2011 was as follows (National Cancer Registry, 2011):

Group - Males 2011	0 – 19 Years	20 – 29 Years	30 – 39 Years	40 – 49 Years	50 – 59 Years	60 – 69 Years	70 – 79 Years	80+ Years
All males	85	49	54	51	56	72	53	14
Asian males	0	0	3	2	2	3	3	0
Black males	53	33	32	29	30	21	13	9
Coloured males	12	7	4	6	5	6	6	1
White males	20	9	15	14	19	34	31	4

Group - Females 2011	0 – 19 Years	20 – 29 Years	30 – 39 Years	40 – 49 Years	50 – 59 Years	60 – 69 Years	70 – 79 Years	80+ Years
All females	61	33	36	33	48	50	42	9
Asian females	3	1	2	0	1	2	1	0
Black females	40	19	22	18	21	18	20	2
Coloured females	9	6	6	7	2	6	6	1
White females	9	7	6	8	24	24	15	6

N.B. In the event that the totals in any of the above tables do not tally, this may be the result of uncertainties as to the age, race or sex of the individual. The totals for 'all males' and 'all females', however, always reflect the correct totals.

Causes of Adult Chronic Myelomonocytic Leukaemia (CMML)
The cause of CMML is not known.

Characteristics of Adult Chronic Myelomonocytic Leukaemia (CMML)
CMML is characterised pathologically by the following:

- Persistent monocytosis is greater than 1×10^9/litre in the peripheral blood.
- No Philadelphia chromosome or *BCR/ABL* fusion gene.
- Fewer than 20% blasts in the blood or bone marrow.
- Dysplasia involving one or more myeloid lineages or, if myelodysplasia is absent or minimal, either an acquired clonal cytogenetic bone marrow abnormality or at least 3 months of persistent peripheral blood monocytosis, if all other causes are ruled out.

Clinical features of CMML include the following:

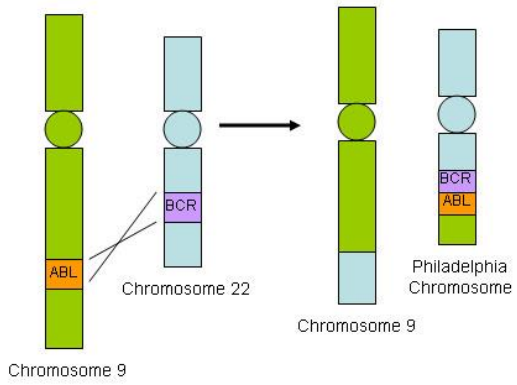
- Fever
- Fatigue
- Night sweats
- Weight loss.
- Infection.
- Bleeding caused by thrombocytopenia.
- Hepatomegaly (in some patients).
- Splenomegaly (in some patients).
- In patients with normal or slightly decreased white blood cell count, clinical features may be identical to MDS.
- In patients with elevated white blood cell count, features are more like chronic myeloproliferative disorders (CMPD), including more frequent splenomegaly and hepatomegaly.

(National Cancer Institute).

Diagnosis of Adult Chronic Myelomonocytic Leukaemia (CMML)

The most important features in confirming the diagnosis are the blood count and bone marrow results. The disease is characterised by increased numbers of monocytes in the blood (greater than 1×10^9/L) and in the marrow. Also, there are fewer than 20% blasts (primitive leukaemic cells) in the marrow and an absence of the BCR/ABL genetic abnormality. There are often chromosome abnormalities, and one rare abnormality may be associated with a response to a specific drug called Glivec.

This abnormality was discovered by Janet Rowley during 1972 and is a consequence of fusion between the Abelson (ABL) tyrosine kinase gene at chromosome 9 and the break point cluster (BCR) gene at chromosome 22, resulting in a chimeric oncogene (BCR/ABL) and a constitutively active BCR/ABL tyrosine kinase that has been implicated in the pathogenesis of CML.
(Leukaemia & Lymphoma Research).



[Picture Credit: ABL/BCR Gene]

Low numbers of other types of blood cells cause many of the signs and symptoms of CMML:

- A shortage of red blood cells (anemia) can lead to feeling very tired, with shortness of breath and pale skin.
- Not having enough normal white blood cells (leukopenia) can lead to frequent or severe infections.
- A shortage of blood platelets (thrombocytopenia) can lead to problems with easy bruising and bleeding. Some people notice frequent or severe nosebleeds or bleeding from the gums.

(American Cancer Society).

The Drug Glivec
Glivec (Imatinib) is a type of treatment called a tyrosine kinase inhibitor. Kinases are important proteins in the body that regulate how the cells grow and divide. Imatinib works by blocking (inhibiting) signals within the cancer cells that make them grow and divide. Blocking the signals causes the cells to die.

Imatinib is licensed to treat people with:

- newly diagnosed CML when a bone marrow transplant isn't suitable
- CML if initial treatment with interferon is no longer working
- advanced CML in the accelerated phase or blast crisis.

(MacMillan Cancer Support).

Staging of Adult Chronic Myelomonocytic Leukaemia (CMML)
Doctors often group cancers into different stages based on the size of the tumor and how far the cancer has spread from the original site in the body. The stage of a cancer can help predict the outlook for a cancer. Often, the stage of a cancer is used to decide which treatment is needed.

Chronic myelomonocytic (MY-eh-loh-MAH-noh-SIH-tik) leukemia (CMML) is a disease of the bone marrow. It cannot be staged by looking at the size of a tumor like some other cancers. Instead, CMML is split into 2 groups based on cell counts in the blood and bone marrow:

- **CMML-1:** Blasts make up less than 5% of white cells in the blood and less than 10% of the cells in the bone marrow.

- **CMML-2:** Blasts make up 5% to 20% of the white cells in the blood, or they make up 10% to 20% of the cells in the bone marrow.

(American Cancer Society).

Treatment of Adult Chronic Myelomonocytic Leukaemia (CMML)
If one has no or few symptoms one may not need treatment at first. Instead the patient will have regular check-ups including blood tests.

The type of treatment needed depends on

- The type of CMML he/she has
- Whether they have symptoms
- Their age
- Whether they have any other medical conditions

Treatments for CMML include
Supportive treatment - this treatment aims to help control the symptoms of CMML. Most people need this type of treatment at some point. The supportive treatment you need depends on the type of symptoms you have. You may need a combination of treatments.

One may have blood transfusions if the red blood cell count is low. And if the platelets are low the patient will have a drip of a clear fluid containing platelets.

Having a lot of blood transfusions can cause a build-up of iron in one's body. Red blood cells contain iron and the body stores this. But too much iron in the body can damage one's heart and liver. To stop this, the patient may need to take medicines to get rid of the extra iron.

Growth factors are drugs that encourage the bone marrow to make more blood cells. We know from research that this can reduce the number of blood transfusions that people need. Erythropoetin is a growth factor that increases the number of red blood cells. So a patient may have this if his/her red blood cell level is low.

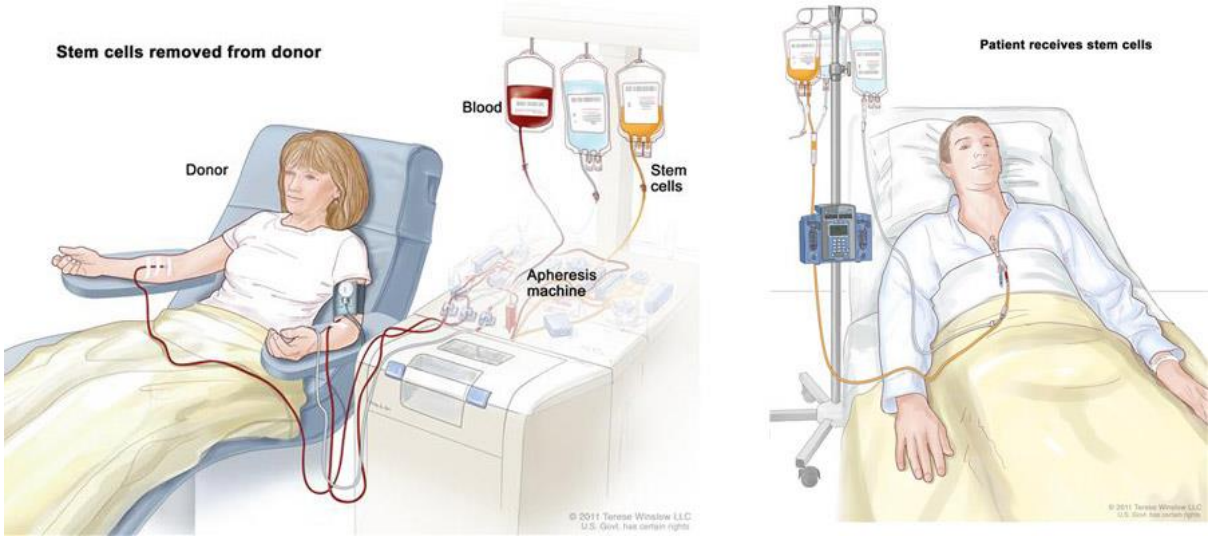
G-CSF is a growth factor that increases the number of white blood cells. So a patient may have this if their white blood cell levels are low.

A patient may have both of these drugs as injections just under the skin (subcutaneously). One may also need to take antibiotics to treat infections.

Chemotherapy - chemotherapy is the main treatment for most people with CMML. It uses cell killing (cytotoxic) drugs to destroy the immature monocyte cells. The drugs work by disrupting the growth of cells and stopping them from dividing. One may have chemotherapy as a tablet, an injection just under your skin, or as an injection into a vein. A patient may have just one drug or a combination of drugs.

The type of chemotherapy one has depends on the type of CMML and the patient's general health. If one has just been diagnosed, the first chemotherapy is likely to be cytarabine, hydroxyurea or azacitidine.

Donor stem cell transplant - in a donor stem cell transplant the patient has a very high dose of chemotherapy. He/she may also have total body irradiation (TBI). These treatments destroy the cells in the bone marrow. This treatment is very intensive and may get rid of the CMML completely but it is not suitable for everyone.



[Picture Credit: Donor Stem Cell Transplant]

After the high dose treatment the patient has stem cells from a donor through a drip into the bloodstream. The stem cells make their way into the bone marrow and start to make normal

blood cells. It takes from a few days to a few weeks for the numbers of blood cells to become normal. During this time the patient will need blood and platelet transfusions and are at a high risk of developing infections. So the doctor and nurses will give the patient antibiotics and antiviral drugs to try to prevent them.

This treatment is very intense and has risks. Patients can only usually have it if they are under 60 and are in reasonably good health, apart from the CMML. To be able to have this treatment the patient needs a stem cell donor. The donor is someone whose stem cells match that of the patient. The most suitable donor is usually a close relative such as a brother or sister.

Newer treatments - doctors and researchers are looking into a number of other treatments for myeloproliferative / myelodysplastic disorders. They are testing a new cancer drug treatment called decitabine. This is similar to azacitidine. They are also looking at different ways of using azacitidine.
(Cancer Research UK).

Prognosis (Outcome) of Adult Chronic Meylomonocytic Leukaemia (CMML)
Between 15 and 30% of cases of CMML will progress to Acute Myeloid Leukaemia (AML). Median survival* in CMML is around 20 months but ranges from about 10 months to over 5 years. There is no difference in survival between the MDS and MPN types of CMML. In a disease with such a variable prognosis it is very important for patients to discuss their with the treating physician.

Median Survival
Median survival is often misunderstood by patients and family to mean the maximum expected lifespan. In Fact, it is the time at which one would expect half of a group of patients diagnosed at the same time to still be alive – many of those still alive will live for many more years, decades even. It is also important to realise that not all patients who die after being diagnosed with CMML, die from CMML. Particularly in the case of elderly patients, many will die from other diseases. Finally, one should always remember that survival data is historical and may not reflect improvements based on newer drugs or treatments.

About Clinical Trials
Clinical trials are research studies that involve people. These studies test new ways to prevent, detect, diagnose, or treat diseases. People who take part in cancer clinical trials have an opportunity to contribute to scientists' knowledge about cancer and to help in the development of improved cancer treatments. They also receive state-of-the-art care from cancer experts.

Types of Clinical Trials
Cancer clinical trials differ according to their primary purpose. They include the following types:

Treatment - these trials test the effectiveness of new treatments or new ways of using current treatments in people who have cancer. The treatments tested may include new drugs or new combinations of currently used drugs, new surgery or radiation therapy techniques, and vaccines or other treatments that stimulate a person's immune system to fight cancer. Combinations of different treatment types may also be tested in these trials.

Prevention - these trials test new interventions that may lower the risk of developing certain types of cancer. Most cancer prevention trials involve healthy people who have not had cancer; however, they often only include people who have a higher than average risk of developing a specific type of cancer. Some cancer prevention trials involve people who have had cancer in the past; these trials test interventions that may help prevent the return (recurrence) of the original cancer or reduce the chance of developing a new type of cancer.

Screening - these trials test new ways of finding cancer early. When cancer is found early, it may be easier to treat and there may be a better chance of long-term survival. Cancer screening trials usually involve people who do not have any signs or symptoms of cancer. However, participation in these trials is often limited to people who have a higher than average risk of developing a certain type of cancer because they have a family history of that type of cancer or they have a history of exposure to cancer-causing substances (e.g., cigarette smoke).

Diagnostic - these trials study new tests or procedures that may help identify, or diagnose, cancer more accurately. Diagnostic trials usually involve people who have some signs or symptoms of cancer.

Quality of life or supportive care - these trials focus on the comfort and quality of life of cancer patients and cancer survivors. New ways to decrease the number or severity of side effects of cancer or its treatment are often studied in these trials. How a specific type of cancer or its treatment affects a person's everyday life may also be studied.

Where Clinical Trials are Conducted

Cancer clinical trials take place in cities and towns in doctors' offices, cancer centres and other medical centres, community hospitals and clinics. A single trial may take place at one or two specialised medical centres only or at hundreds of offices, hospitals, and centres.

Each clinical trial is managed by a research team that can include doctors, nurses, research assistants, data analysts, and other specialists. The research team works closely with other health professionals, including other doctors and nurses, laboratory technicians, pharmacists, dieticians, and social workers, to provide medical and supportive care to people who take part in a clinical trial.

Research Team

The research team closely monitors the health of people taking part in the clinical trial and gives them specific instructions when necessary. To ensure the reliability of the trial's results, it is important for the participants to follow the research team's instructions. The instructions may include keeping logs or answering questionnaires. The research team may also seek to contact the participants regularly after the trial ends to get updates on their health.

Clinical Trial Protocol

Every clinical trial has a protocol, or action plan, that describes what will be done in the trial, how the trial will be conducted, and why each part of the trial is necessary. The protocol also includes guidelines for who can and cannot participate in the trial. These guidelines, called eligibility criteria, describe the characteristics that all interested people must have before they can take part in the trial. Eligibility criteria can include age, sex, medical history, and current health status. Eligibility criteria for cancer treatment trials often include the type and stage of cancer, as well as the type(s) of cancer treatment already received.

Enrolling people who have similar characteristics helps ensure that the outcome of a trial is due to the intervention being tested and not to other factors. In this way, eligibility criteria help researchers obtain the most accurate and meaningful results possible.

National and International Regulations

National and international regulations and policies have been developed to help ensure that research involving people is conducted according to strict scientific and ethical principles. In these regulations and policies, people who participate in research are usually referred to as "human subjects."

Informed Consent

Informed consent is a process through which people learn the important facts about a clinical trial to help them decide whether or not to take part in it, and continue to learn new information about the trial that helps them decide whether or not to continue participating in it.

During the first part of the informed consent process, people are given detailed information about a trial, including information about the purpose of the trial, the tests and other procedures that will be required, and the possible benefits and harms of taking part in the trial. Besides talking with a doctor or nurse, potential trial participants are given a form, called an informed consent form, that provides information about the trial in writing. People who agree to take part in the trial are asked to sign the form. However, signing this form does not mean that a person must remain in the trial. Anyone can choose to leave a trial at any time—either before it starts or at any time during the trial or during the follow-up period. It is important for people who decide to leave a trial to get information from the research team about how to leave the trial safely.

The informed consent process continues throughout a trial. If new benefits, risks, or side effects are discovered during the course of a trial, the researchers must inform the participants so they can decide whether or not they want to continue to take part in the trial. In some cases, participants who want to continue to take part in a trial may be asked to sign a new informed consent form.

New interventions are often studied in a stepwise fashion, with each step representing a different "phase" in the clinical research process. The following phases are used for cancer treatment trials:

Phases of a Clinical Trial

Phase 0. These trials represent the earliest step in testing new treatments in humans. In a phase 0 trial, a very small dose of a chemical or biologic agent is given to a small number of people (approximately 10-15) to gather preliminary information about how the agent is

processed by the body (pharmacokinetics) and how the agent affects the body (pharmacodynamics). Because the agents are given in such small amounts, no information is obtained about their safety or effectiveness in treating cancer. Phase 0 trials are also called micro-dosing studies, exploratory Investigational New Drug (IND) trials, or early phase I trials. The people who take part in these trials usually have advanced disease, and no known, effective treatment options are available to them.

Phase I (also called phase 1). These trials are conducted mainly to evaluate the safety of chemical or biologic agents or other types of interventions (e.g., a new radiation therapy technique). They help determine the maximum dose that can be given safely (also known as the maximum tolerated dose) and whether an intervention causes harmful side effects. Phase I trials enrol small numbers of people (20 or more) who have advanced cancer that cannot be treated effectively with standard (usual) treatments or for which no standard treatment exists. Although evaluating the effectiveness of interventions is not a primary goal of these trials, doctors do look for evidence that the interventions might be useful as treatments.

Phase II (also called phase 2). These trials test the effectiveness of interventions in people who have a specific type of cancer or related cancers. They also continue to look at the safety of interventions. Phase II trials usually enrol fewer than 100 people but may include as many as 300. The people who participate in phase II trials may or may not have been treated previously with standard therapy for their type of cancer. If a person has been treated previously, their eligibility to participate in a specific trial may depend on the type and amount of prior treatment they received. Although phase II trials can give some indication of whether or not an intervention works, they are almost never designed to show whether an intervention is better than standard therapy.

Phase III (also called phase 3). These trials compare the effectiveness of a new intervention, or new use of an existing intervention, with the current standard of care (usual treatment) for a particular type of cancer. Phase III trials also examine how the side effects of the new intervention compare with those of the usual treatment. If the new intervention is more effective than the usual treatment and/or is easier to tolerate, it may become the new standard of care.

Phase III trials usually involve large groups of people (100 to several thousand), who are randomly assigned to one of two treatment groups, or “trial arms”: (1) a control group, in which everyone in the group receives usual treatment for their type of cancer, or 2) an investigational or experimental group, in which everyone in the group receives the new intervention or new use of an existing intervention. The trial participants are assigned to their individual groups by random assignment, or randomisation. Randomisation helps ensure that the groups have similar characteristics. This balance is necessary so the researchers can have confidence that any differences they observe in how the two groups respond to the treatments they receive are due to the treatments and not to other differences between the groups.

Randomisation is usually done by a computer program to ensure that human choices do not influence the assignment to groups. The trial participants cannot request to be in a particular group, and the researchers cannot influence how people are assigned to the groups. Usually, neither the participants nor their doctors know what treatment the participants are receiving.

People who participate in phase III trials may or may not have been treated previously. If they have been treated previously, their eligibility to participate in a specific trial may depend on the type and the amount of prior treatment they received.

In most cases, an intervention will move into phase III testing only after it has shown promise in phase I and phase II trials.

Phase IV (also called phase 4). These trials further evaluate the effectiveness and long-term safety of drugs or other interventions. They usually take place after a drug or intervention has been approved by the medicine regulatory office for standard use. Several hundred to several thousand people may take part in a phase IV trial. These trials are also known as post-marketing surveillance trials. They are generally sponsored by drug companies.

Sometimes clinical trial phases may be combined (e.g., phase I/II or phase II/III trials) to minimize the risks to participants and/or to allow faster development of a new intervention.

Although treatment trials are always assigned a phase, other clinical trials (e.g., screening, prevention, diagnostic, and quality-of-life trials) may not be labelled this way.

Use of Placebos

The use of placebos as comparison or "control" interventions in cancer treatment trials is rare. If a placebo is used by itself, it is because no standard treatment exists. In this case, a trial would compare the effects of a new treatment with the effects of a placebo. More often, however, placebos are given along with a standard treatment. For example, a trial might compare the effects of a standard treatment plus a new treatment with the effects of the same standard treatment plus a placebo.

Possible benefits of taking part in a clinical trial

The benefits of participating in a clinical trial include the following:

- Trial participants have access to promising new interventions that are generally not available outside of a clinical trial.
- The intervention being studied may be more effective than standard therapy. If it is more effective, trial participants may be the first to benefit from it.
- Trial participants receive regular and careful medical attention from a research team that includes doctors, nurses, and other health professionals.
- The results of the trial may help other people who need cancer treatment in the future.
- Trial participants are helping scientists learn more about cancer (e.g., how it grows, how it acts, and what influences its growth and spread).

Potential harms associated with taking part in a clinical trial

The potential harms of participating in a clinical trial include the following:

- The new intervention being studied may not be better than standard therapy, or it may have harmful side effects that doctors do not expect or that are worse than those associated with standard therapy.
- Trial participants may be required to make more visits to the doctor than they would if they were not in a clinical trial and/or may need to travel farther for those visits.

Correlative research studies, and how they are related to clinical trials

In addition to answering questions about the effectiveness of new interventions, clinical trials provide the opportunity for additional research. These additional research studies, called correlative or ancillary studies, may use blood, tumour, or other tissue specimens (also known as 'biospecimens') obtained from trial participants before, during, or after treatment. For example, the molecular characteristics of tumour specimens collected during a trial might be analysed to see if there is a relationship between the presence of a certain gene mutation or the amount of a specific protein and how trial participants responded to the treatment they received. Information obtained from these types of studies could lead to more accurate predictions about how individual patients will respond to certain cancer treatments, improved ways of finding cancer earlier, new methods of identifying people who have an increased risk of cancer, and new approaches to try to prevent cancer.

Clinical trial participants must give their permission before biospecimens obtained from them can be used for research purposes.

When a clinical trial is over

After a clinical trial is completed, the researchers look carefully at the data collected during the trial to understand the meaning of the findings and to plan further research. After a phase I or phase II trial, the researchers decide whether or not to move on to the next phase or stop testing the intervention because it was not safe or effective. When a phase III trial is completed, the researchers analyse the data to determine whether the results have medical importance and, if so, whether the tested intervention could become the new standard of care.

The results of clinical trials are often published in peer-reviewed scientific journals. Peer review is a process by which cancer research experts not associated with a trial review the study report before it is published to make sure that the data are sound, the data analysis was performed correctly, and the conclusions are appropriate. If the results are particularly important, they may be reported by the media and discussed at a scientific meeting and by patient advocacy groups before they are published in a journal. Once a new intervention has proven safe and effective in a clinical trial, it may become a new standard of care.
(National Cancer Institute).

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Sources and References

ABL/BCR Gene
https://www.google.co.za/search?q=bcr+abl+gene&source=lnms&tbm=isch&sa=X&ei=C_bVU-QTicXsBuOagZgO&ved=0CAYQ_AUoAQ&biw=1517&bih=714&dpr=0.9#facrc=_&imgdii=_&imgrc=JBr6YJSMhx_M6M%253A%3BZpadlYmDTBU_lM%3Bhttp%253A%252F%252Fbestpractice.bmj.com%252Fbest-practice%252Fimages%252Fbp%252Fen-gb%252F276-2_default.jpg%3Bhttp%253A%252F%252Fbestpractice.bmj.com%252Fbest-practice%252Fmonograph%252F276%252Fbasics%252Fpathophysiology.html%3B423%3B313

American Cancer Society
http://www.cancer.org/cancer/leukemia-chronicmyelomonocyticcmml/detailedguide/leukemia-chronic-myelomonocytic-signs-symptoms

Blood Cells
https://www.google.co.za/search?q=chronic+myelodysplastic+leukemia&source=lnms&tbm=isch&sa=X&ei=S_DVU7moBoTE7AbovYH4DA&ved=0CAYQ_AUoAQ&biw=1517&bih=714&dpr=0.9#facrc=_&imgdii=_&imgrc=7OSAalg9KPEdQM%253A%3BRkfTY1UPS9WK_M%3Bhttp%253A%252F%252Fwww.cancerresearchuk.org%252Fprod_consump%252Fgroups%252Fcr_common%252F%2540cah%252F%2540gen%252Fdocuments%252Fimage%252Fcrukmig_1000img-12065.jpg%3Bhttp%253A%252F%252Fwww.cancerresearchuk.org%252Fcancer-help%252Fabout-cancer%252Fcancer-questions%252Fchronic-myelomonocytic-leukaemia-cmml%3B400%3B314

Cancer Research UK
http://www.cancerresearchuk.org/cancer-help/about-cancer/cancer-questions/chronic-myelomonocytic-leukaemia-cmml#treat

Donor Stem Cell Transplant
https://www.google.co.za/search?q=stem+cell+transplant+procedure&source=lnms&tbm=isch&sa=X&ei=YAHWU6mDHrSB7QbZy4CoAw&ved=0CAYQ_AUoAQ&biw=1517&bih=714&dpr=0.9#facrc=_&imgdii=_&imgrc=FlGBam2-kEBrxM%253A%3BAOirYB0f56xQOM%3Bhttp%253A%252F%252Fpubweb.fccc.edu%252Fcancerconversations%252Fwp-content%252Fuploads%252F2014%252F02%252FStemCellTransplant.jpg%3Bhttp%253A%252F%252Fpubweb.fccc.edu%252Fcancerconversations%252F2014%252F02%252Fis-there-an-age-limit-for-stem-cell-transplant%252F%3B900%3B400

Leukaemia & Lymphoma Research
https://leukaemialymphomaresearch.org.uk/information/leukaemia/chronic-myelomonocytic-leukaemia-cmml

MacMillan Cancer Support
http://www.macmillan.org.uk/Cancerinformation/Cancertreatment/Treatmenttypes/Biologicaltherapies/Cancergrowthinhibitors/Imatinib.aspx

National Cancer Institute
http://www.cancer.gov/cancertopics/pdq/treatment/mds-mpd/HealthProfessional/page2
http://www.cancer.gov/about-cancer/treatment/clinical-trials/what-are-trials