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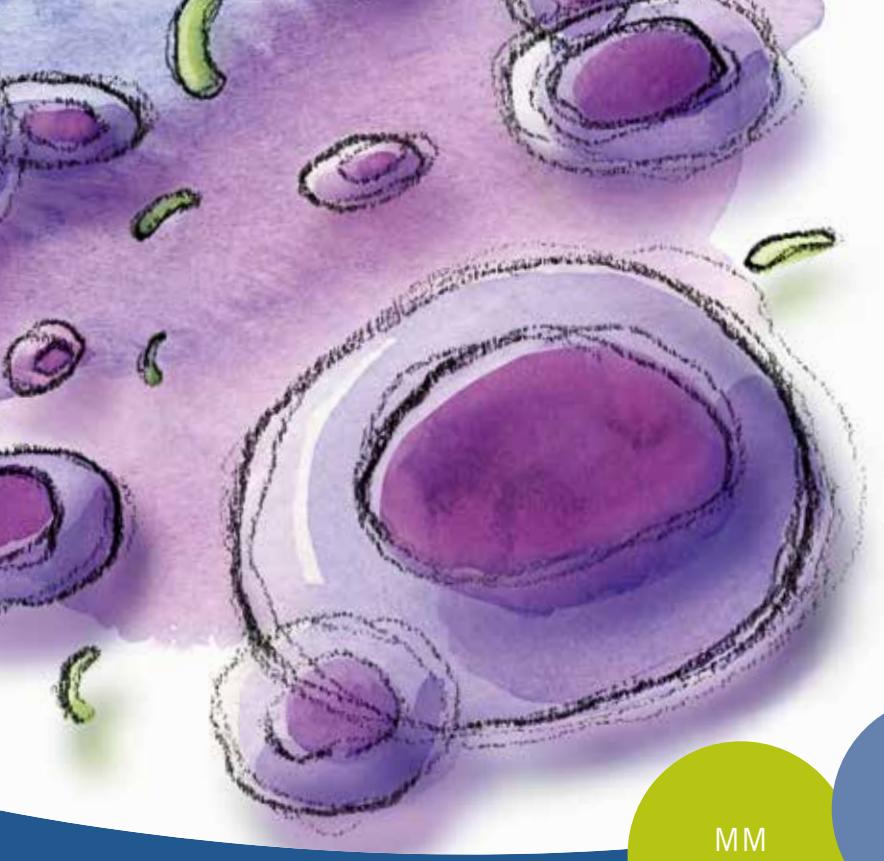

MM
ENGLISCH

Updated
edition
2016

Multiple Myeloma (MM)

A brochure for patients and their families

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Content

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Preface

Dear Reader!

Multiple myeloma is a form of cancer which originates in plasma cells. Normally, plasma cells are responsible for producing antibodies which are an important component of the immune response. They help to detect and eliminate intruders. A myeloma is the clonal accumulation of plasma cells, i. e. many pathological daughter cells develop from a single malignant cell. The term "multiple" describes that the body of most patients shows multiple pathological foci in different areas of the skeleton. The disease is accompanied by a decay of the bone structure and an increase in plasma cells inhibits normal blood formation. A deficiency in red blood cells, white blood cells and platelets develops.

Good supportive treatment is important in multiple myeloma therapy. Since the disease varies greatly from patient to patient it is important to consult with the attending physician in a personal talk about the state of your disease and your personal prognosis.

Our brochure will help you understand your own body. We made sure to provide illustrations with important facts in addition to the explanations in the text which will allow you to better understand what is going on in an organism affected by multiple myeloma. This may not always be an easy time for you. We wish you the will and courage to master your future in your very own, personal way and people around you who will be your loyal companions on your journey.

Best wishes,
Professor Monika Engelhardt, M.D. Stefanie Hornung, Ph.D.

Blood

Blood components

Blood accounts for about one-twelfth of an adult's weight. It consists of many different components.

The blood plasma (about half of the blood) consists of 90 percent water. The substances important for the metabolism (carbohydrates, fats, amino acids, vitamins, minerals) are dissolved in it and transported via the blood to the different organ systems.

A large number of proteins are also dissolved in the blood plasma. They serve many different functions:

- Nutrition
- Transport
- Carrier
- Pressure regulation of bodily fluids
- Buffer for acids and bases (pH value)
- Defence against diseases
- Protection from blood loss (coagulation)

The other half of the blood consists of blood cells:

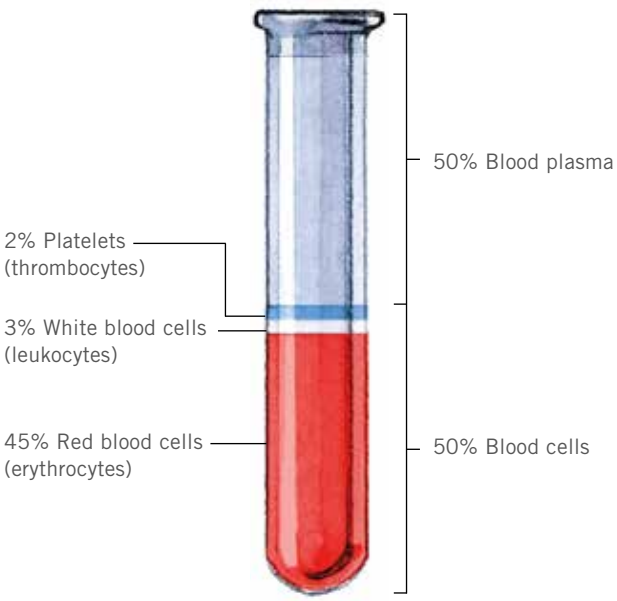
- 2 percent platelets (thrombocytes)
- 3 percent white blood cells (leukocytes)
- 45 percent red blood cells (erythrocytes)

The blood's tasks

Blood has numerous tasks. It transports oxygen vital for all metabolic processes from the lung into cells with the help of red blood cells (erythrocytes). Carbon dioxide released by cellular respiration (intake of oxygen into the cell and release of carbon dioxide) is returned to the lungs via the blood. Furthermore, blood also supplies nutrients, messenger substances (hormones) and chemical substances to the cells, while waste products such as creatinine, urea and uric acid are transported from the cells over the kidneys to the excretory organs. Blood also assumes important tasks to protect the body from infections.

Blood composition

Erythrocytes, leukocytes and thrombocytes are produced in the bone marrow, a sponge-like tissue inside large bones.



Blood composition: Blood is often called a "liquid organ" since it contains a variety of different cells

Erythrocytes

Erythrocytes contain the red blood pigment called haemoglobin which binds oxygen and transports it to the different tissues and organs. People with anemia, for example, typically have a low red blood count resulting in an insufficient oxygen supply in the body. Anaemia can be diagnosed with a blood count. The blood count shows the amount of haemoglobin in gram per decilitre of blood (g/dl). The normal haemoglobin range is between 11 and 18; in women it is usually a bit lower than in men.

Leukocytes

The white blood cells, classified by the three main types

- granulocytes,
- monocytes and
- lymphocytes (B lymphocytes),

are part of the immune system. A healthy body contains approx. 4,000 to 10,000 leukocytes per microlitre (µl) of blood. Lymphocytes play a key role in the *adaptive* immune response, while monocytes and granulocytes are important for the *innate* response. Granulocytes and monocytes neutralise bacteria. The *innate* immune response is impaired by a deficiency of these cells.

Thrombocytes

The platelets (thrombocytes) are of particular importance during the first phase of coagulation after injuries, because they stop the bleeding by clumping and forming a clot (thrombus) to close the wound. Certain blood proteins (called coagulation factors) are also involved in the process. Between 140,000 and 360,000 platelets per microlitre (µl) of blood are considered normal and less than 10,000/µl is an important limit. If the level falls below this limit there is severe platelet deficiency (thrombocytopenia) which may lead to life-threatening bleeding.

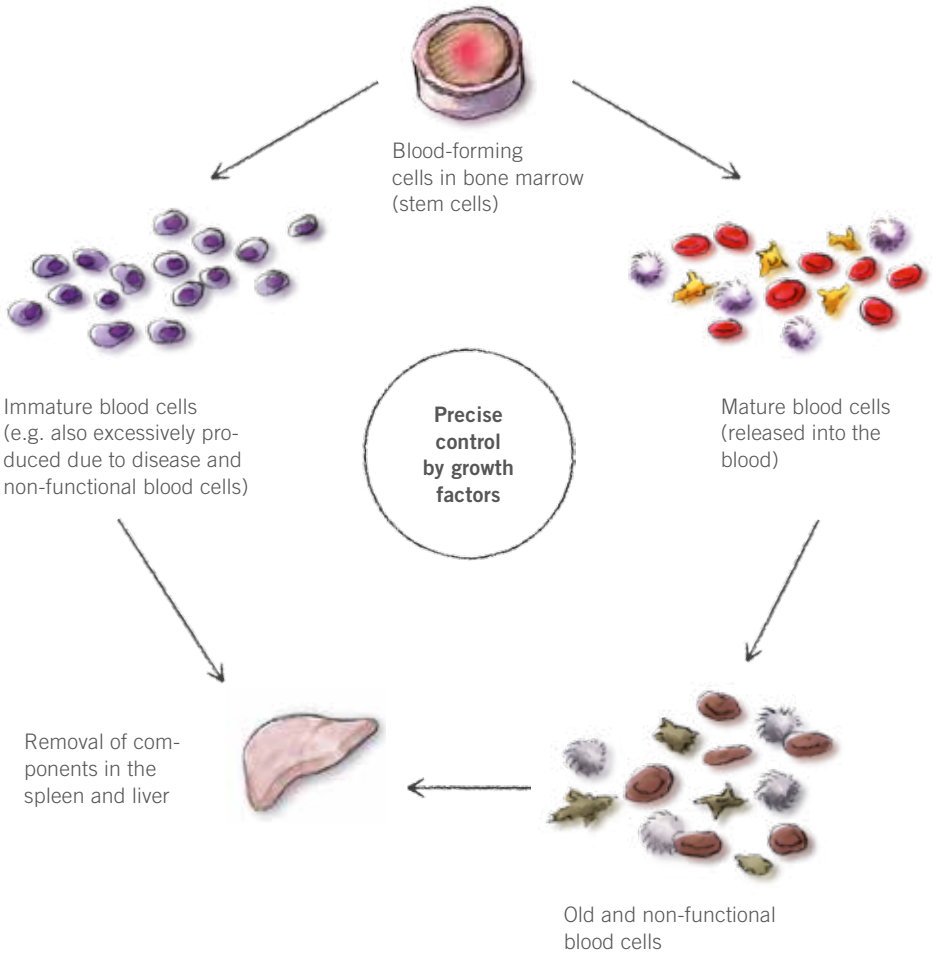
Blood formation – a dynamic balance

Blood cells have only a limited lifetime. They must be constantly produced so that there is always a sufficient amount of working cells available. They are all generated from stem cells which are mainly located in the bone marrow. In embryos blood formation mainly takes place in the spleen and liver, in adults it takes place in the bone marrow.

Stem cells are special, undifferentiated cells. They either differentiate into specialised cells or multiply by division.

Since the bone marrow stores stem cells, it has enough source material at any given time to produce the different blood cells. The metabolism can only work without problems, if the correct number of each cell type is present in the blood at all times. Blood formation follows strict rules and is regulated by growth factors.

The newly produced blood cells are released into the blood after their differentiation in the bone marrow. Lymphocytes predominantly migrate into the lymphatic system where they multiply and regenerate or even specialise for a specific task in the immune defence. Old blood cells which have lost their function are removed by the liver and spleen.



Blood formation is an accurately controlled process which ensures that sufficient blood cells are available at any given time to fulfil vital tasks

The most important lab parameters

The following is a list of the most important lab parameters pertaining to blood formation; these can vary from lab to lab:

Red blood cells
Erythrocytes

Haemoglobin (Hb)

Men:	13–18 g/dl
Women:	11–16 g/dl

Erythrocyte count
4–6 million/µl

Platelets
Thrombocytes

Thrombocyte count
140,000–360,000/µl

Immunoglobulins Ig (adults)

IgG	700–1,600 mg/dl
IgA	70–500 mg/dl
IgM	men 40–230 mg/dl
	women 40–280 mg/dl
IgE	up to 100 IU/ml
IgD	< 100 IU/ml

White blood cells
Leukocytes

Leukocyte count
4,000 – 10,000/µl

Leukocytes in the differential blood count

Granulocytes:	45–70%
- Neutrophil granulocytes:	55–65%
- Eosinophil granulocytes:	up to 5%
- Basophil granulocytes:	up to 1%
Lymphocytes:	15–40%
Monocytes:	2–10%

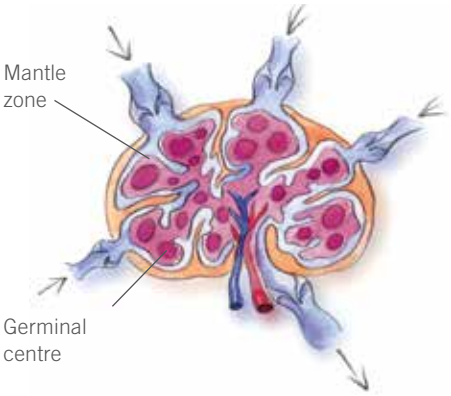
Blood plasma

Total protein
64–83 g/l

The Human Immune System

The organs of the immune system

The human body is constantly under attack from pathogenic (infectious) bacteria, viruses, fungi or other parasites. It has defence systems (immune system) to defend itself against these attacks. We distinguish between an innate (non-specific) immune system and an adaptive (specific) immune response. Both systems are closely interlinked. The immune system is located in different organs of the body, especially in the lymphatic system and in the blood. The specific cells of the immune system constantly patrol the body through the lymph and blood vessels.



Longitudinal view of a lymph node

Lymph nodes

The human body has approximately 500 to 1,000 lymph nodes which are also sometimes referred to as glands. In healthy patients the lymph nodes are hardly palpable, but with inflammations or infections they grow in size and are easily palpated.

There is an abundant supply of lymphocytes in the germinal centre of the lymph nodes which can be quickly released, if necessary. The actual physical defence reaction occurs in the reaction centre. As soon as the lymph contains bacteria or other foreign bodies which are recognised to be foreign through their surface antigens the B lymphocytes develop specific antibodies against these antigens. Other cells of the immune system "devour" the pathogens or destroy infected body cells.

Spleen

The spleen is located in the posterior abdominal space on the left side between the ninth and the eleventh rib. It is attached to the stomach and the abdominal wall. Its normal size is about that of a small fist. The spleen normally consists of soft, hardly palpable tissue, however, it can swell up significantly and become palpable in certain disorders.

The spleen has many tasks:

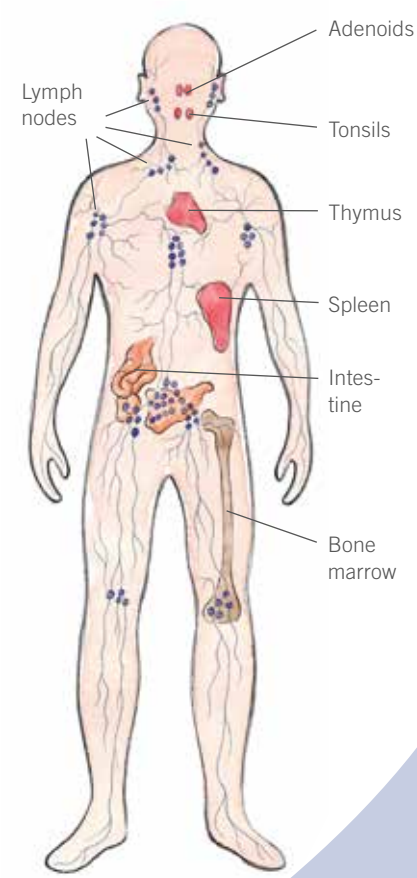
- Formation of lymphocytes
- Removal of red blood cells
- Storage of blood
- Blood formation during embryonic development

Thymus

The thymus is a lobulated lymphoid organ located in the chest behind the sternum. A large number of lymphocytes are stored in its cortex, which can be quickly released, if necessary. The thymus grows during the embryonic development of humans and then continuously decreases in size in adults. Chronic debilitating disorders lead to a regression of the thymus, acute disorders result in its enlargement.

Tonsils

A group of tonsils forms an annular defence around the airways and digestive tracts. This formation is called Waldeyer's tonsillar ring. Another group of tonsils which is embedded into the oesophageal mucosa catches infectious pathogens before they can enter the body.



The organs of the immune system

The innate immune response

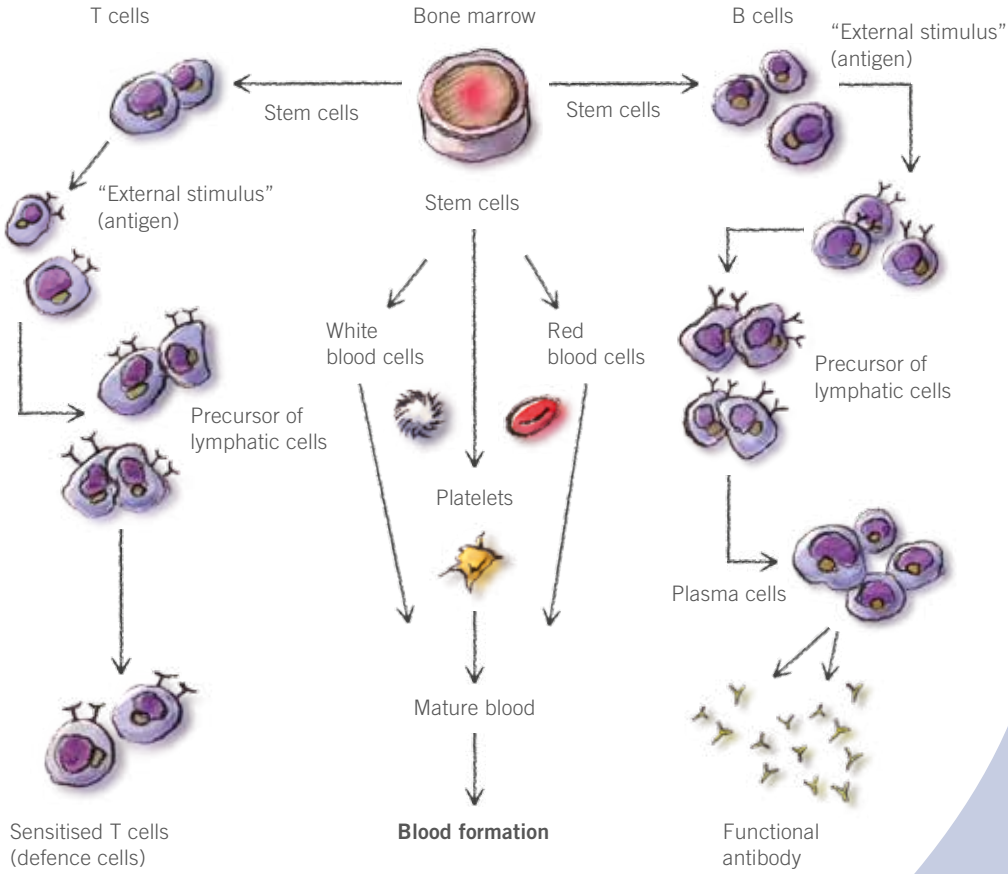
The innate immune response of the body is responsible for warding off bacteria and viruses, sometimes also for the removal of bodily substances, for example, for the disposal of red blood cell remains. The innate immune response involves proteins, messenger substances, aggressive compounds, phagocytes ("devouring cells") and granulocytes. The last group forms a subgroup of white blood cells (leukocytes) which are formed in the bone marrow. The granulocytes are not only active in the blood and tissue, but also in the mucous membranes of the body, e.g. in the mouth. When bacteria enter the body, messenger substances are released which lure the granulocytes to the danger zone. There, they are eliminated.

The adaptive immune response

Phagocytes ("devouring cells") are highly effective against many bacteria. However, they are sometimes ineffective against some types. The body's innate immune response is also helpless against most viruses. In this case the body's adaptive immune response effectively intervenes. It is formed from antibodies, enzymes and other substances, which are dissolved in the bodily fluids (humoral), and from different kinds of lymphocytes.

The B cells (B lymphocytes) mature in the bone marrow from precursor cells. The T cells (T lymphocytes) develop in the thymus. Cells in embryos and infants already begin to distinguish between the body's own tissue and foreign cells. During adulthood both types of lymphocytes, originating from the spleen and the lymph nodes, circulate through the body in the cardiovascular and lymphatic system until they are either eliminated or they perform their tasks for the immune system.

Immunoglobulins (antibodies) are formed by plasma cells which originate from activated B lymphocytes. The antigens fit to the intruding foreign substances like a key fits into a lock. They detect and bind to these enabling the special "devouring cells" to dispose of them. Besides plasma cells B lymphocytes also produce memory cells which memorise the structure and characteristics of the antigen and therefore quickly produce the appropriate antibody type during an attack of the same pathogen. In addition to the humoral immune response there is also the cellular immune response called T lymphocytes. Together with macrophages T cells are able to effectively kill certain pathogens as well as destroy infected or degenerated body cells.



The formation of mature and functional blood cells from multipotent blood stem cells

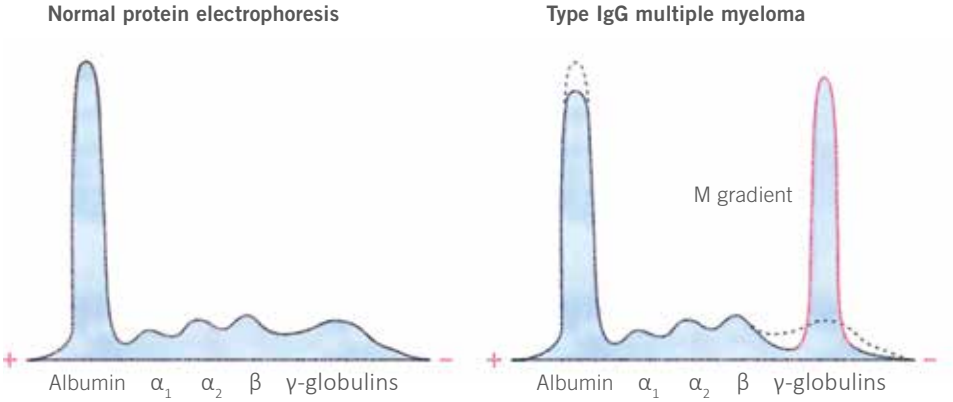
Multiple Myeloma (MM)

What is multiple myeloma?

Multiple myeloma is a form of cancer which affects the plasma cells in the bone marrow. Plasma cells originate from the B lymphocytes after a maturation process. They are responsible for the production of antibodies against foreign proteins and therefore play an important role in the (adaptive) immune response. Normally, the human immune system has a full array of different antibodies to be prepared against all kinds of infections. The antibodies belong to the immunoglobins of the classes IgG, IgA, IgM, IgE and IgD.

A myeloma is the clonal multiplication of plasma cells. It develops through the malignant change of a "clone" plasma cell, hence the term "clone". Several of such cell accumulations can be found at different sites of the body in the case of multiple myeloma. The degenerated plasma cells (myeloma cells) produce either complete antibodies which are called paraproteins (M gradient) or only their fragments which are called light chains. Myeloma cells characteristically produce only antibodies of a certain kind of immunoglobulins. Immunoglobulin G is with 60 percent the most commonly degenerated form here, and immunoglobulin A with 20 percent is the second most common. Other immunoglobulins are only rarely affected. The paraproteins are often non-functional, and there are usually no healthy antibodies. Therefore the body is no longer able to protect itself as effectively from infections. In about 99 percent of patients paraproteins can be detected in urine and blood through various methods, e.g. via gel electrophoresis (refer to the following image).

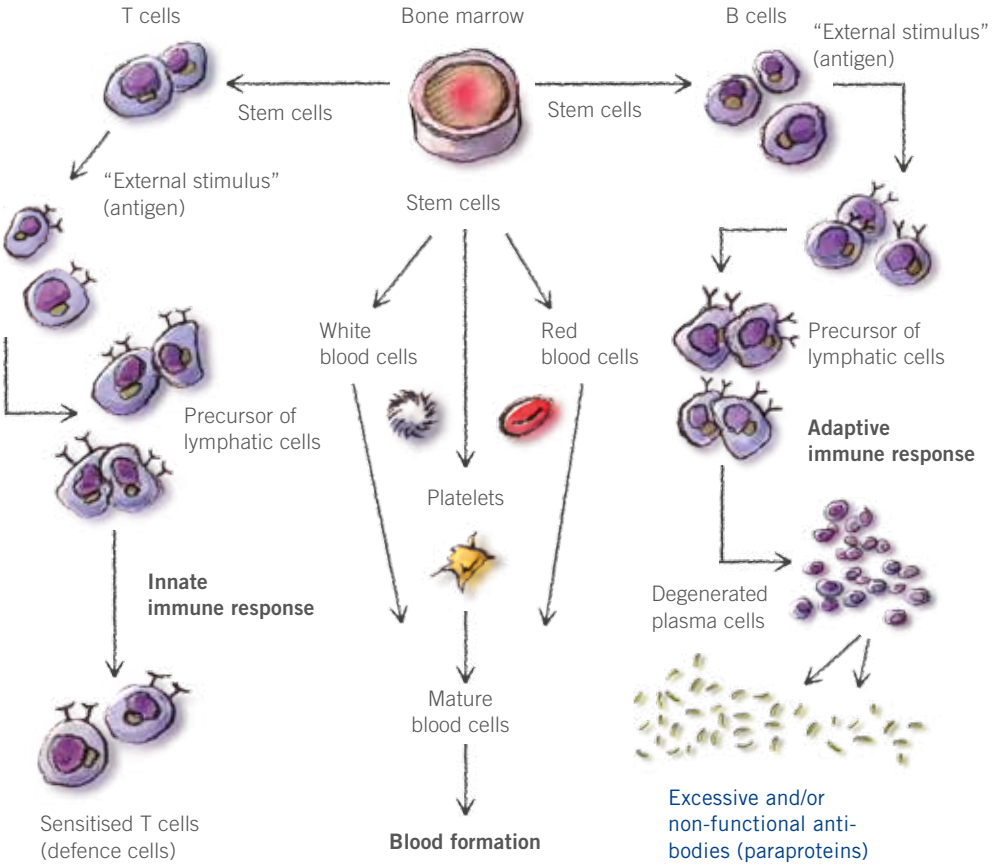
In addition to the multiplication of plasma cells, the production of healthy blood cells is inhibited in the bone marrow which results in a low red blood cell count. This causes fatigue and a loss of performance capacity. Also, bleeding and febrile infections can occur when too few platelets or white blood cells are formed.



Detection of multiple myeloma using gel electrophoresis. The serum gel electrophoresis of a healthy subject (shown left) and the serum gel electrophoresis of a patient with myeloma with clearly visible M gradient (shown right)

Plasma cells typically form additional substances which activate the degeneration of bone tissue. Local bone degeneration can occur in the bone tissue (bone lesions), especially in the region of the spinal column, pelvis, ribs and skull. The patient experiences pain and the risk of bone fractures increases. Bone tissue is rich in calcium and phosphate. If this dissolves its components are released and transported via the blood path into the kidneys that can be damaged as a result. The paraprotein, too, causes damage to the small filtration units of the kidneys.

The large quantity of paraprotein also causes the blood to thicken. The blood becomes more viscous and moves more slowly throughout the body. Circulatory disorders are a consequence.



The formation of functional plasma cells is impaired with multiple myeloma: Plasma cells mutate to myeloma cells and produce excessive and/or non-functional antibodies (paraproteins)

Who develops multiple myeloma?

Men develop multiple myeloma slightly more often than women. The reasons for this are unknown. The average age at the onset of the disease is about 69 years. First-degree relatives have a slightly (1.8 to 2 times) higher risk of developing the disease.

What are the symptoms of multiple myeloma?

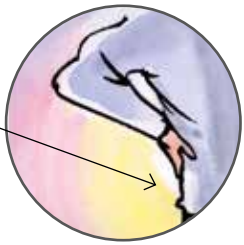
About 70 percent of patients have already developed painful bone lesions at the time of the diagnosis. The bone structure is weakened and the bone density is lower than that of a healthy person. Fractures can occur due to major trauma but can also be the result of minor trauma. These are in most cases located on the lower spine and also in the region of the ribs. Since back pain is relatively common and mostly related to other causes, multiple myeloma is often diagnosed late.

A weak immune system can cause lung infections, bronchitis or sinusitis. Infections of the urinary tract, the gastrointestinal tract or the skin can also occur.

About ten percent of patients have elevated calcium levels. These cause extreme thirst, nausea, vomiting and also dehydration of the body.

Patients who were diagnosed with multiple myeloma should immediately consult with their attending physician if they occasionally feel confused, have headaches and impaired vision. Also irregular bleeding (e.g. when brushing teeth) can be caused by a myeloma.

Possible symptoms of multiple myeloma

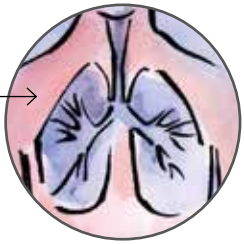


Bones and central nervous system

- Back pain*, height loss and bone loss (osteoporosis) in men and in women before menopause
- Spinal cord compression and subsequent loss of strength in the lower limbs and bladder problems

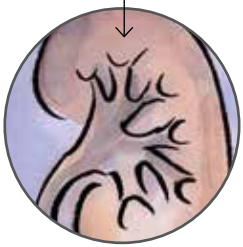
Bone marrow

- Lack of red blood cells causing different degrees of anaemia
- Lack of white blood cells causing severe infections, for example of the lungs
- Rare: Lack of platelets causing excessive bleeding



Miscellaneous

- Reduced kidney function
- Elevated blood calcium level (hypercalcaemia)
- Elevated viscosity of the blood plasma



*Causes for back pain are classified according to frequency: unspecific causes, herniated disk, rheumatic diseases, orthopaedic back pain, osteoporosis in old age, monoclonal gammopathy of unknown significance, multiple myeloma

How is multiple myeloma diagnosed?

The symptoms of multiple myeloma are similar to those of other diseases. A diagnosis is mostly considered as verified, if:

- In the bone marrow of the patient an increased amount of plasma cells (> 10 percent) is detectable (with myeloma: typically 20 – 30 percent)
- In the blood and/or urine excessive/non-functional antibodies (M protein/paraprotein) or parts thereof (Bence Jones protein) can be detected
- Other diseases have been excluded which can cause the above-mentioned or similar clinical pictures (e.g. hepatitis)

Additionally, the following examinations are advisable.

Blood tests:

- Determination of the serum creatinine level to check the kidney function
- Determination of the calcium level
- Determination of the amount of ß2-microglobulin (ß2-MG) + albumin
- Determination of free light chains in the serum (FLC assay)

Radiographic imaging:

- Whole body computed tomography (CT) and/or
- Whole body magnetic resonance imaging (MRI)

Based on what characteristics is multiple myeloma classified?

The classification (staging) of multiple myeloma is performed on the basis of the number of myeloma cells and their specific features, (e.g. their division speed). The Durie Salmon staging system is most commonly used. It attempts to determine the spreading of the disease in the body and is based on the characterisation of the bone lesions and on the interpretation of lab parameters.

Classification according to the Durie Salmon staging system:

Durie and Salmon – Stage I: All points must apply.	
Hb value	> 10 g/dl
Serum calcium level	Normal
X-ray	Normal bone structure (0) or single bone lesion
Low paraprotein concentration	IgG < 50 g/l IgA < 30 g/l
Light chains of paraprotein in urine	< 4 g/24 h
Durie and Salmon – Stage II: Neither stage I nor stage III apply.	
Durie and Salmon – Stage III: One or more points apply.	
Hb value	< 8.5 g/dl
Serum calcium level	> 3.00 mmol/l
X-ray	Progressive bone lesions (3)
High paraprotein concentration	IgG > 70 g/l IgA > 50 g/l
Light chains of paraprotein in urine	> 12 g/24 h

Kidney function test (subclassification A and B)

A	Relatively normal kidney function, serum creatinine value < 2 mg/dl (170 µmol/l)
B	Reduced kidney function, serum creatinine value ≥ 2 mg/dl (170 µmol/l)

The International Staging System (ISS) is also frequently used. The ISS is based on two parameters: the serum concentrations of the proteins ß2-MG and albumin. High serum concentrations of ß2-MG are a reliable sign for a high number of myeloma cells in the body. ß2-MG therefore is a prognostic factor.

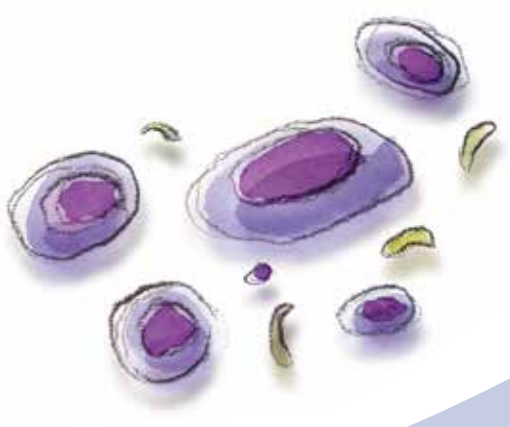
The international staging system was recently revised due to new research results (ISS-R). It now includes

- the LDH level and
- the cytogenic risks of myeloma cells

in order to more accurately define myeloma which results in improved stage classification of patients.

Classification according to ISS:

Stage	Criteria	Definition
ISS – I	Low ß2-MG	ß2-MG < 3.5 mg/l and albumin ≥ 3.5 g/dl
ISS – II	Neither stage I nor stage III	ß2-MG < 3.5 mg/l and albumin < 3.5 g/dl or ß2-MG 3.5 mg/l ≤ 5.5 mg/l
ISS – III	High ß2-MG	ß2-MG ≥ 5.5 mg/l



How is multiple myeloma treated?

Sometimes patients are incidentally diagnosed with multiple myeloma (asymptomatic myeloma), although they have no typical symptoms of myeloma such as an elevated calcium level in the blood (C), renal insufficiency (R), anaemia (A), or bone lesions (B) (CRAB criteria). Up till now these patients were not treated, instead they were monitored at close intervals.

Recently, however, it is also valid with asymptomatic patients (according to CRAB criteria): If the bone marrow contains more than 60% of myeloma cells, the physician finds an increase in light chain ratio of more than 100 in the blood and/or more than one bone lesion of more than 5 mm in diameter is detected in the MRI, this is classified as active myeloma and it is discussed with the patient whether the disease should already be treated.

The treatment of multiple myeloma is differentiated. Supportive measures serve to monitor the disease to the extent that other organs are impacted as late as possible or not at all. For example the kidneys need to be protected to maintain their functionality.

There are several options for the treatment of the disease itself which are described from page 24.

What are supportive treatment measures?

Bone disease and pain management

Occasionally, orthopaedic surgery is necessary to treat fractures which more frequently occur due to the degenerative bone structure. Radiotherapy can confine the tumour and subsequently help to alleviate pain and/or prevent bone fractures. It is important for patients to stay mobile, which is why physical therapy and guided excercise is an important part of treatment.

Compression of the spinal cord

Compression of the spinal cord is a severe complication in myeloma patients. It often remains undiagnosed and develops in the course of the disease. Patients with the following symptoms should immediately see their attending physician:

- Loss of sensory functions or paralysis in the lower torso and lower limbs
- Difficulties with urination
- Bladder dysfunction, incontinence

If the physician detects a compression of the spinal cord, the patient is immediately hospitalised. The exact localisation of the tumour mass is determined through imaging techniques. The patient receives surgery or local radiation. Chemotherapy is often also applied.

Anaemia

Two-thirds of all myeloma patients suffer from anaemia. It is often not very serious unless there are also other causes which further promote anaemia such as blood loss. Blood transfusions may become necessary in the case of severe anaemia. For other patients, especially those with kidney damage, the administration of erythropoietin may be reasonable to stimulate the formation of red blood cells.

Infections

Infections are potentially life threatening for the patient. It is important that patients with myeloma immediately seek medical attention if they experience initial signs of an infection (especially with fever above 38.5 degrees Celsius). Annual influenza vaccinations are advisable.

Testing and maintenance of the kidney function

The recommended bodily fluid intake should be adhered to in all cases. Drugs which could harm the kidney function should be avoided. It is absolutely imperative that all over-the-counter drugs taken are discussed with the attending physician. Special care must be taken with painkillers and x-ray contrast media (intravenous contrast medium). Other measures are also taken to maintain the kidney function and are described in the following.

Hypercalcaemia

Elevated blood calcium levels can be corrected through the prescribed administration of intravenous solutions and bisphosphonates.

Increased viscosity of the blood

There are a number of measures which can be used to treat possible circulation problems. These include, e.g. therapeutic plasma exchange (plasmapheresis). If the level of paraprotein is very high, chemotherapy is administered parallel to this in order to sustainably and effectively reduce the amount of plasma cells that produce the paraprotein.

How is multiple myeloma treated as the primary disease?

Chemotherapy

Substances are used in chemotherapy which inhibit the growth of tumour cells. The treatment must be repeated at certain intervals in order to effectively reduce the tumour mass. Chemotherapy is indicated if the following CRAB criteria are met:

- Hypercalcaemia (C)
- Renal insufficiency (R)
- Anaemia (A)
- Bone lesions (B)

High-dose therapy with autologous stem cell transplantation

According to the treatment guidelines, a high-dosed chemotherapy in combination with an infusion of previously obtained autologous blood stem cells is recommended for patients who are under the age of 75 and in a good physical constitution. This form of therapy leads for most patients to a very good remission of the myeloma. How long this lasts varies from patient to patient.

High-dose therapy with allogeneic stem cell transplantation

In allogeneic stem cell transplantation the stem cells of a suitable donor are transplanted after high-dose therapy. Due to the higher risk of infection and the risk of transplant (Graft-versus-host) rejection, this form of therapy is currently limited and preferably used in clinical trials with young patients who are in very good general health and have a high-risk multiple myeloma.

New substances

For several years a range of new substances have become available for the therapy of multiple myeloma.

The treatment of the primary disease must be adapted to the other accompanying diseases, to renal insufficiency or to a current therapy. The drugs must be selected carefully to minimise an additional burden, e.g. due to comorbidities.

Complete or permanent cure of multiple myeloma is rare. However, conventional and especially also new types of therapy can keep the disease under control over a longer period which may result in an increased life expectancy and an improved quality of life for the patient.

Important terms for the disease

A

Allogeneic
Not from the patient but coming from a different donor

Anaemia
The body has insufficient red blood cells and is therefore insufficiently supplied with oxygen. Symptoms of anaemia: fatigue, shortness of breath, weakness, lack of drive, loss of performance capacity

Antibiotic drug(s)
Substance administered to treat bacterial infections

Antibodies
Also called immunoglobulins; proteins which are formed by certain white blood cells and are able to detect and bind to certain antigens; antibodies are important components of the human immune system.

Antigens
Structures which can trigger an immune response

Autologous
Coming from the patient

B

B cells
→ Lymphocytes

Basophil (granulocytes)
White blood cells (→ leukocytes) which play an important role in allergic reactions; since they belong to the category of → granulocytes, they are also called basophil granulocytes.

Biopsy
The removal and examination of a small piece of tissue from the body (for an accurate diagnosis)

Blasts
Immature cells in the bone marrow from which blood cells originate

Blood cells
→ Erythrocytes, → leukocytes and → thrombocytes

Blood formation
Process of the formation and maturation of blood cells

Bone marrow
Tissue filling the inside of the bone; yellow and red bone marrow; blood formation takes place in the red bone marrow.

Bone marrow biopsy
Removal of a tiny piece of tissue from the bone marrow to extensively examine it; sometimes also called bone marrow punch

Bone marrow puncture
Removal of cells from the bone marrow with a needle to extensively examine them; sometimes also called bone marrow aspiration

Bone marrow transplantation
Transfer of bone marrow; either bone marrow from a donor is used (allogeneic) or the bone marrow of the patient is used (autologous). Chemotherapy is performed before the transplantation.

C

Chemotherapy
Type of treatment where the cancer cells are killed by the administration of special drugs (cytotoxins; → cytostatic drugs)

Chromosomes
Carriers of the genetic make-up

Computed tomography (CT)
Diagnostic, computer-assisted imaging technique

Cytogenetic tests
Examination of the → chromosomes with microscopy to determine possible changes of the genetic make-up

Cytokines
Messenger substances of the human body which control growth processes

D

Depression
Psychological illness which is accompanied by a gloomy mood, loss of interest, joy, and motivation

Differential blood count
The distribution of different white blood cells is examined in percent in the differential blood count. It distinguishes white blood cells such as → granulocytes, → lymphocytes and → monocytes.

Differentiation
In the context of cells: the maturation of a precursor cell to a healthy "adult" cell with special tasks which can vary from tissue to tissue

E

Embryonic development
The first three months of human development in the mother's womb

Enzymes
Proteins formed in cells which accelerate the numerous biochemical processes in the organism

Eosinophils
A category of white blood cells which fight parasites and play an important role in allergic reactions

Erythrocytes
Red blood cells which transport the oxygen from the lungs to the cells and bring the carbon dioxide produced by cellular respiration out of the body and back to the lungs

Erythropoietin
Erythropoietin is a blood growth factor generated in the kidney. Erythropoietin controls the formation of red blood cells.

G

Graft-versus-host disease (GvHD)
Immune reaction which can occur in the transmission of immunocompetent cells; in the course of this, the immune cells contained in the graft of the donor (especially T lymphocyctes) attack the recipient organism (particularly affected: skin, liver and intestine); possible complication of an allogeneic stem cell transplantation

Granulocytes
Certain type of white blood cells (→ leukocytes); classified in → neutrophils, → eosinophils and → basophils; granulocytes make up about 60 to 70 percent of white blood cells and are responsible for the killing of bacteria.

Growth factors
Hormones which control the developmental processes in the body; blood growth factors control the blood formation, e.g. erythropoietin or G-CSF are such growth factors.

H

Haematocrit
The part of the entire blood volume consisting of solid components

Haematologist
Specialist of blood diseases

Haematopoiesis
The biological processes which are part of the → blood formation

Haemochromatosis
Iron overload of organs

Haemoglobin
Red blood colour which is responsible for oxygen transport in the → erythrocytes

Host-versus-graft disease (HvGD)
Reaction of the immune system of the recipient organism which recognises the cells of the organ donor as foreign and attempts to destroy them; possible complication of an allogeneic stem cell transplantation; organ rejection after organ transplantations is also such a reaction.

Hypercalcaemia
Elevated calcium level in the blood serum

I

Immune competence
Ability of certain cells of the immune system to detect external substances and render them harmless

Immune response
Reaction of the body to external substances

Immune system
Defence system of the body in which different organs are involved

Immunomodulation
Influence of the body's own immune system so that it can fight and eliminate the tumour cells

L

Leukaemia
Malignant disorder where an excess of non-functional white blood cells is produced

Leukocytes
White blood cells; play an important role in the innate immune system

Leukopenia
A lack of white → blood cells

Lymphatic system
Tonsils, spleen, thymus, lymph nodes and lymphatic vessels

Lymphocytes
Subgroup of white blood cells; play an important role in the immune system

M

Macrophages
"Devouring cells" of the → immune system that engulf and "digest" intruders and defective cells of the body

Metabolic processes
Processes in the body which in the end are performed to supply it with energy and dispose of the waste materials

Microlitre (µl)
One-thousandth of a millilitre

Monocytes
A category of → white blood cells which is responsible for the defence against bacteria

Mutation
Sudden, undirected change of genetic make-up

Mutation status
Statement regarding whether a gene has mutated or not

Myelosuppression
Change in the → bone marrow (through disease or therapy) in which the production of all or individual blood cell types is reduced

N

Neutrophil granulocytes
A category of white → blood cells which play an important role in the infection defence of the body

P

Packed red blood cells
Blood transfusions where red blood cells of a donor are administered

Pelvic crest
The upper part of the pelvic bone from where samples are taken during a → bone marrow biopsy

PET (positron emission tomography)
Imaging method

Phagocytes
“Devouring cells” of the immune system

Plasma
The liquid, non-cellular component of blood

Platelets
Stop the bleeding after injury (→ thrombocytes); platelet deficiency leads to an increased susceptibility for bleeding.

Prognosis
The expected course of a disease and the associated life expectancy

Prophylaxis
Prevention

Psychological
Concerning the mind

R

Red blood cells
→ Erythrocytes

Rejection reaction
The human body can distinguish between foreign and own tissue and often rejects foreign tissue.

S

Somatic
Concerning the body

Specific
Characteristic

Stem cells
Special type of bodily cells which can either divide into two identical daughter cells or differentiate into different cells with different tasks; the stem cells important to → blood formation are located in the → bone marrow.

Supportive
Assisting

T

T cells
→ Lymphocytes

Thrombocytopenia
Abnormally low amount of platelets

Transfusion
A method of bringing donor blood or donor platelets into the bloodstream; not to be confused with an infusion where solutions with medicinal components are brought into the bloodstream

U

Unspecific
Not characteristic

W

White blood cells
→ Leukocytes

Useful addresses

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Telephone +49/228/3 38 89-200
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www.LHRM.de
www.myelom.net (Myelom-Gruppe LHRM)
www.mds-patienten-ig.org
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Notes