

## Immunoglobulins – vitally important constituents of our blood

Immunoglobulins (antibodies) are endogenous proteins which circulate in the blood and perform diverse vitally important tasks. They are an important component of our immune system.

Human blood contains the immunoglobulin classes IgM, IgG, IgA, IgD and IgE, which differ from each other in their structure and in their properties.

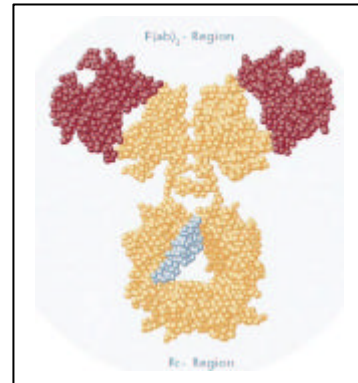
The predominant type of antibody in human blood is **Immunoglobulin G** (IgG). It accounts for 70-75 percent of the total quantity of antibodies. In one millilitre of blood there are  $10^{16}$  IgG antibodies.

On account of their structure IgM and IgG bind to the viruses and bacteria that have invaded the body in an infection, to products of the metabolism of bacteria (toxins), and also to substances which are formed in the body during inflammation or when cells are destroyed, and then get into the bloodstream. This gives rise to what are known as immune complexes which are recognised and then destroyed by certain blood cells, the macrophages.

Due to their construction, immunoglobulins are also capable of binding to the surface of blood cells or to certain organ cells by means of receptors (binding sites), and influencing the behaviour of these cells.

In this way, cell multiplication and cell maturation, and also the activity and interaction of cells of our immune system, are regulated.

By binding to cells, immunoglobulins have an effect on the control of inflammatory processes, on the regeneration of destroyed tissue after injuries or surgical operations and also on the maintenance of organ functions. They are important for the communication between our immune system and the nervous system, coagulation of the blood and the vascular system.



### How are antibodies formed?

The formation of antibodies is the response by immune cells in the blood to what is known as an antigenic stimulus. The triggering factors (antigens) can be bacteria and the products of their metabolism (toxins), viruses and cell constituents.

These antigens bind onto binding sites on all immune cells and thus trigger various reactions in the cells. In the first phase (three to seven days) only antibodies of the IgM type are produced. This is done exclusively by B cells in the blood. IgM antibodies are the first line of defence against invading infectious pathogens and prevent the further spread of an infection. We are born with this reaction.

The lifetime of IgM antibodies is very short compared with other antibodies. It is only about seven days. As an infection has not usually disappeared completely in this time or as there may still be foci of infection in the body, other antibodies (IgG, IgA) are produced in parallel with IgM. We are not born with this mechanism – it is “learned”.

It requires the interaction of various blood cells: T cells, B cells and macrophages are informed by binding sites on their cell surface about the invasion of pathogens and start to communicate with each other via released messenger substances or by direct cell-to-cell contact. The cells multiply and then carry within themselves all the same information about the pathogen to be controlled. Ultimately there is a large number of the same type of B cells available, and sufficient antibodies are produced against the pathogen. The majority of these antibodies are of the IgG type and have a survival time of three to four weeks.

- **Antibody production as a learning process**

Cell-to-cell communication is an essential part of a learning process which our immune system goes through and which is of major importance for our survival.

To be protected from infections, our body still needs the antibodies from our mother for the first few weeks of life. It is not until eight to twelve weeks after birth that our immune cells have learned to communicate effectively with each other and to perform various tasks.

It is also part of this learning process that what has been learned is retained for as long as possible. To do this, our immune system creates an immunological memory. After each first contact with an antigen the B and T cells affected divide, mature into functional cells and thus create a fairly large stock of cells whose activity is directed against the antigen which provoked this process.

From this stock of cells, most B cells develop into antibody-producing cells. However, a proportion of these B cells stick at an early stage of development and are preserved as what are known as memory cells for a fairly long period.

The memory cells are specialised to recognise certain antigens and can be activated within a few hours following renewed contact with the antigen they already know. IgG antibodies are then produced within the first 48 hours after an infection. The defence against infection is therefore more efficient than after the initial infection. The infection takes a less severe course or may even pass practically unnoticed. In this way lifelong protection may even be achieved against certain pathogens.

### **Antibody concentrates as therapeutic agents**

Immunoglobulin preparations in the form of antibody concentrates are used for the treatment of patients with a congenital or acquired antibody deficiency, and also for the treatment of patients with autoimmune diseases.

In comparison with blood, these preparations contain five or ten times the quantity of IgG antibodies per millilitre of fluid. Thus many millions of antibodies can be administered if required within a short time to assist the body's immune defence, to inhibit inflammation and to promote tissue regeneration.

The preparations are obtained from human blood plasma, which is virus inactivated, purified of unwanted residuals and concentrated. Obtaining the plasma and also the production of immunoglobulin preparations are subject to stringent national and international guidelines. In Germany, every batch of an immunoglobulin preparation is tested by the Federal Institute for Sera and Vaccines [Bundesinstitut für Seren und Impfstoffe (Paul-Ehrlich-Institut)] before it is released for treatment.