

# **A to Z GLOSSARY OF IMMUNOLOGICAL TERMS**

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**A to Z**

**GLOSSARY**

**OF IMMUNOLOGICAL TERMS**

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## **PREFACE**

The publication A to Z Glossary of Immunological Terms is intended for students of medicine, dentistry, non-medical study programs, as well as for doctors, researchers and health professionals. The terminological dictionary is one of the outputs of the projects KEGA 038UK-4/2019 and KEGA 032UK-4/2019 Ministry of Education, Slovak Republic.

The immune system, together with the nervous and endocrine systems, forms one of the essential systems needed to maintain the body's existence. The immune system tries to ensure that all processes in the body take place physiologically, correctly, and therefore can be considered a vital system. In the field of immunology, many new findings are being added, the implementation and use of which may be complicated and confusing in practice. At a time of increasing immune system disorders, allergic, autoimmune, cancer, primary and secondary immunodeficiencies, we anticipate an increased interest in immunology, clinical immunology and allergology.

The human body has developed sophisticated protective and defence mechanisms within the immune system that protect it from microorganisms and their virulence factors. The immune system has three key properties: a number of very diverse receptors that allow the recognition of an almost unlimited number of antigens; an immune memory prepared to elicit the required immune response rapidly and almost immediately; and immunological tolerance to prevent damage to one's tissues and organs.

By creating a terminological dictionary, we aimed to ensure that every student or person interested in this issue has the opportunity to quickly and effectively get acquainted with the terminology used in immunology and successfully advance in the study.

MUDr. Martina Neuschlová, PhD.

A B C D E F G H I J K L M N  
O P R S T U V W X Y Z

A

### **Acute GvH disease**

Symptoms of acute GvH disease might include any of the following: skin rash or reddened areas on the skin, yellow discolouration of the skin and/or eyes, and abnormal blood test results, nausea, vomiting, diarrhoea, or abdominal cramping.

### **Acute-phase proteins**

Acute-phase proteins are a class of proteins whose plasma concentrations increase in the acute phase of inflammation in the body (positive acute-phase proteins). For this reason, their measurement can be used for diagnostic purposes. They are primarily synthesized in the liver in response to upstream inflammatory signals. Their synthesis is enhanced by inflammatory cytokines (IL-1, IL-6, TNF  $\alpha$ ). Frequently investigated proteins of the acute phase of inflammation include  $\alpha$ -1-antitrypsin (A1AT),  $\alpha$ -2-macroglobulin (A2M), orosomucoid (ORM), ceruloplasmin (Cpl), fibrinogen, C-reactive protein, procalcitonin.

### **Adaptive immune response**

Also known as acquired immune response or adaptive immunity. It is the response of antigen-specific lymphocytes to an antigen. Major signs of adaptive immunity are memory and specificity. An important difference between the adaptive and innate immune system is the development of immunological memory. Adaptive immunity against newly encountered antigens initially develops slowly (primary response). However, secondary responses against the same antigens are typically faster and more vigorous than the primary responses. Adaptive immune responses are generated by clonal selection of lymphocytes. Many cells derived from the lymphoid lineage are responsible for adaptive immune responses (lymphocytes and plasma cells). Many other cells are important for both innate and adaptive immune responses. Cells of adaptive immunity undergo basic development in thymus (T-cells) and bone marrow (B cells). T-cells play a key role in cell-mediated adaptive immune responses as well as regulating the activities of other cells. B-

cells play a crucial role in humoral-mediated adaptive immunity based on the actions of antibodies produced and secreted by plasma cells.

### **ADCC (Antibody-Dependent Cell-mediated Cytotoxicity)**

Antibody-dependent cell-mediated cytotoxicity is the killing of antibody-coated target cells by cells with FcR receptors on their surface that recognize the constant (Fc) part of the bound antibody. Many cell types have Fc receptor on their surface and are therefore able to bind the Fc part of the antibody. Most ADCC reactions are mediated by Natural Killer cells (NK cells) that have the Fc receptors on their surface. The cytolytic process used by NK cells in ADCC is similar to mechanisms utilized by cytotoxic T-cells to kill the invaders. ADCC is not the same as phagocytosis. The targets for ADCC are generally too big to be phagocytosed and the killing is extracellular (in phagocytosis the microorganism is ingested and killed intracellularly).

### **Adjuvant**

it is mixed. For example, the reaction to diphtheria toxoid is increased if the toxoid is adsorbed (attached) to particles of aluminium hydroxide or aluminium phosphate. An adjuvant is a substance that increases the body's reaction to a foreign substance.

### **Affinity**

Affinity is the strength of binding of one molecule to another at a single site, e.g. the binding of a monovalent Fab fragment of antibody to a monovalent antigen.

**Ag (antigen)** – see antigen

### **Agar**

It is a gelatin-like product made primarily from the red algae. Agar belongs to the galactan polysaccharides. Best known as a solidifying component of bacteriological culture media.

### **Agarose**

Agarose is a neutral polymer component of agar. Heating of agarose gives rise to solution form which on cooling sets into gel form. Routine use agarose is ideal for the analysis of nucleic acids by gel electrophoresis or blotting and is also suitable for protein applications such as Ouchterlony and radial immunodiffusion (RID).

### **Agglutination**

Antigen-antibody reaction is defined as the formation of clumps of cells or inert particles by specific antibodies to the surface antigenic components (direct agglutination) or antigenic components adsorbed or chemically coupled to red blood cells or inert particles, e.g. latex (passive hemagglutination and passive latex agglutination, respectively).

### **Agglutinin**

A substance (such as an antibody) producing agglutination. A substance that makes particles stick together to form a clump or a mass.

### **Agranulocyte**

A mononuclear white blood cell (leukocyte) without cytoplasmic granules. Two types of agranulocytes are in the blood circulation – lymphocytes and monocytes. The next types of



agranulocytes are the macrophages formed in the tissue when monocytes leave the circulation and differentiate into macrophages.

### **Albumin**

A type of protein found in blood, egg white, milk, and other substances.

### **Allergen**

A substance (antigen) that causes an allergic response. Allergens in the individuals with the genetic predisposition to develop IgE-mediated responses cause type I. hypersensitivity. Examples include pollen, moulds, or certain foods, drugs...

### **Allergic reaction**

A hypersensitive immune reaction (also called immediate hypersensitivity) to an antigen that normally is harmless or would not cause an immune response in most people. An allergic response may cause harmful symptoms such as itching or inflammation or tissue injury. These reactions are rapid (within minutes of exposure to an antigen) and involve IgE-mediated response. Basophils and mast cells are important in allergic reactions. People with genetic predisposition to develop IgE-mediated responses to common allergens develop IgE antibodies in response to relative harmless antigen (called an allergen) after the first contact with them. IgE bind to Fc receptors on the surface of mast cells and basophils. Exposure to the allergen may cause cross-linking of surface-bound IgE that leads to mast cell and basophil degranulation and the rapid release of vasoactive amines (e.g. histamine) and other inflammatory mediators from mast cells and basophils. It results in the contraction of smooth muscle in the vasculature (vasoconstriction) combined with vasodilatation of capillary endothelium that leads in fluid accumulation in the tissue - oedema, contraction of smooth muscle surrounding the bronchi in the respiratory tract that may cause decreasing the size of the bronchial lumen and breathing difficulties. Examples of localized reactions are asthma, allergic dermatitis, an example of a systemic reaction is anaphylaxis (anaphylactic shock).

### **Alloantigen**

An antigen presents only in some but not all individuals of the same species and capable of inducing the production of alloantibodies by individuals who lack it.

### **Allogeneic**

Taken from different individuals of the same species. Also called allogeneic.

### **Allograft**

An allogeneic graft is a transplant of tissue, organ, or cells from one individual to another individual of the same species (allogenic) who is not an identical twin. The allograft is transferred between for example brother and sister, parent and child, or unrelated people.

### **Allotypes**

Allotypes are allelic polymorphisms that can be detected by antibodies specific for the polymorphic gene products. Allotypic differences in immunoglobulin molecules were important in deciphering the genetics of antibodies.

## ANA

**AntiNuclear Autoantibodies.** ANA is typically found in patients with inflammatory rheumatic diseases, especially systemic lupus erythematosus (SLE), mixed connective tissue disease (MCTD, also known as Sharp syndrome), polymyositis/dermatomyositis, Sjögren's syndrome and scleroderma. ANA is thus partial markers for the individual connective tissue disorders. The isolated detection of the individual autoantibodies allows for the serological differentiation of these diseases. The standard technique for the detection of ANA is immunofluorescence that is highly suitable for autoantibody screening. The indirect immunofluorescence test is the method of choice in the serodiagnosis.

## Anaphylatoxins

Anaphylatoxins are small fragments of complement proteins (C5a, C4a, C3a) released by cleavage during complement activation. These anaphylatoxins can act as chemical signals promoting vascular permeability and can attract leukocytes to the site of inflammation or injury. Anaphylatoxins are recognized by specific receptors and they recruit inflammatory cells to sites of their release.

## Anaphylaxis

or anaphylactic shock is an allergic reaction – type IgE mediated hypersensitivity reaction. It is an immediate response to antigenic challenge with the release of vasoactive amines (mainly histamine), cytokines and other agents causing the capillary leak, wheeze, cyanosis, oedema of the larynx, tongue, lips and eyelids and urticaria. The rapid release of vasoactive amines from mast cells and basophils and release of cytokines results in the contraction of smooth muscle in the vasculature and vasodilation of capillary endothelium accompanied by blood pressure decreasing that leads to cardiovascular shock. Anaphylaxis can result in sharp drops in blood pressure, difficulty in breathing, and death if left untreated.

## Anatoxin (toxoid)

Inactivated toxins called anatoxins or toxoids are no longer toxic but retain their immunogenicity so that they can be used for immunization (vaccination). Toxicity of toxin has been suppressed by chemical (formalin) or heat treatment. Toxins are secreted by bacteria, whereas toxoids are inactivated form of toxins and are not secreted by bacteria. Toxoids can elicit an immune response against the toxin. To increase the immune response, the toxoid is adsorbed to aluminium or calcium salts, which serve as adjuvants. Toxoid vaccines are safe because they cannot cause the disease they prevent and there is no possibility of reversion to virulence.

## ANCA

**Anti-Neutrophilic Cytoplasmic Antibody** is a group of autoantibodies directed against cytoplasmic components of the neutrophilic granulocytes. They have been classified into cytoplasmic (c-ANCA) and perinuclear (p-ANCA) according to the indirect immunofluorescence pattern they give on ethanol-fixed human neutrophils and are useful serological markers for vasculitides. Most c-ANCA and p-ANCA antibodies recognize two major target autoantigens. Proteinase 3 (PR3) and Myeloperoxidase (MPO) respectively. Anti-PR3 have high specificity for Wegener's Granulomatosis. Anti-MPO antibodies have been reported in a variety of vasculitides (e.g. Microscopic polyangiitis, Polyarteritis nodosa) and glomerulonephritides (e.g. Rapidly progressive glomerulonephritis).

## **Anergy**

Anergy is a state of unresponsiveness to an antigen. People are said to be anergic when they cannot mount delayed-type hypersensitivity reactions to challenge antigens. T cells and B cells are said to be anergic when they cannot respond to their specific antigen under optimal conditions of stimulation.

## **Antibody (Ab)**

Also called immunoglobulin, a protective glycoprotein produced by the immune system in response to the presence of a foreign substance (antigen). Antibodies recognize antigens to remove them from the body. When a foreign substance enters the body, the immune system can recognize it as non-self because on the surface of these antigens are molecules different from those found in the body (self). To the elimination of the invaders, the immune system calls on defence mechanisms, including antibody production. B cells produce antibodies. An antigen binds to the B cell surface and stimulates B cells to maturation. The mature B cells (called plasma cells) secrete antibodies, which attack and neutralize antigens that are identical to the one that triggered the immune response. Antibodies remain in circulation for several months and provide extended immunity against a particular antigen. The determination of specific antibodies by serological methods is used in the diagnosis of many infectious diseases.

## **Antibody-Dependent Cell-mediated Cytotoxicity**

A type of immune reaction in which a target cell or microbe is coated with antibodies and killed by certain types of white blood cells. The white blood cells bind to the antibodies and release substances that kill the target cells or microbes. Also called antibody-dependent cellular cytotoxicity. See ADCC.

## **Antibody structure**

The basic structure of these proteins consists of two pairs of polypeptide chains that form a flexible Y shape. The stem of the Y includes one end of each of two identical heavy (H) chains. Each arm is composed of the remaining portion of a heavy chain and smaller protein called the light (L) chain. The two light chains also are identical. The stem and the bottom of the arms are called the constant region (C – constant domains). The tips of the arms are highly variable in sequence (V – variable domains) and bind antigen. Each antibody has two identical antigen-binding sites at the end of each arm.

## **Antigen**

An antigen is a substance that is capable of stimulating an immune response, specifically activating lymphocytes. Their name arises from their ability to generate antibodies. In general, two main groups of antigens are recognized. Foreign antigens originate from outside the body (exogenous antigens e.g. parts of microorganisms or substances produced by microorganisms, proteins in food, red blood cells from other individuals etc.) and autoantigens that originate within the body (endogenous antigens). An antigen that induces an immune response is called immunogen. Corpuscular antigens produce agglutination reactions with antibodies. Corpuscular antigens are, for example, suspensions of bacteria, viruses, yeasts, latex particles, red blood cells. Soluble antigens (for example, bacterial toxins, enzymes, extracts of microorganisms) produce precipitation reactions with antibodies.

## Antigen presentation

Antigen presentation describes the display of antigen as peptide fragments bound to MHC molecules on the surface of an antigen-presenting cell. T cells recognize antigen when it is presented in this way.

## Antigen-presenting cells (APCs)

Antigen-presenting cells are highly specialized cells that can process antigens and display their peptide fragments on the cell surface together with molecules required for T-cell activation. The main antigen-presenting cells for T cells are dendritic cells, macrophages and B cells.

## Antigenic determinant

Also called an epitope, portion of a foreign antigen, that is capable to stimulate an immune response. An antigenic determinant is the part of the antigen that binds to a specific antigen receptor on the surface of a B cell. Binding between the receptor and antigenic determinant occurs only if their structures are complementary (like a puzzle) that is necessary to activate B cell production of antibodies. These antibodies are essentially identical to the receptor of the B cell that produced it. Antibodies are targeted specifically to the antigenic determinants. Many antigens have a variety of distinct antigenic determinants on their surface, which are capable of reacting with different B cell receptors.

## Antigenic drift

Point mutations of viral genes cause small differences in the structure of viral surface antigens (e.g. influenza virus varies from year to year by this process).

## Antigenic mimicry – molecular mimicry

Molecular mimicry is a process in which infection by particular microbes is associated with the subsequent development of specific autoimmune diseases. The antigens of some microbial agents are similar to some host self molecules. B and T cell responses generated against antigens of infectious agents can result in damage to host cells bearing similar molecules.

## Antigenic shift

Antigenic shift occurs when two or more viruses combine to form a new type having a mixture of the surface antigens. Genetic exchange between the two types of viruses can generate new hybrid viruses. Influenza viruses undergo antigenic shift periodically through reassortment of their segmented genome with another influenza virus, changing their surface antigens radically. Antigenic shift variants are not recognized by individuals immune to influenza, so when antigenic shift variants arise, there is a widespread and serious disease.

## Antihistamines

A type of drug that blocks the action of histamines, which can cause fever, itching, sneezing, a runny nose, and watery eyes. Antihistamines that target the histamine H1-receptor are used to treat allergies, coughs, and colds. Besides they may be used to treat insomnia, motion sickness, or vertigo caused by problems with the inner ear. Antihistamines that target the histamine H2-receptor are used to treat gastric acid conditions (e.g. acid gastroesophageal reflux disease and peptic ulcer).



## **Antiserum**

Antiserum is the human or animal fluid component of blood serum from an immune individual that contains monoclonal or polyclonal antibodies against the antigen used for immunization. Antisera are used to spread passive immunity to many diseases and in diagnostic laboratories. Monoclonal antibodies are produced by a single clone of B lymphocytes. Polyclonal antibodies are secreted by different B cell lineages within the body.

## **Antitoxin**

An antibody that is capable of neutralizing the specific toxin (such as a specific causative agent of disease) that stimulated its production in the body and is produced in animals for medical purposes by injection of a toxin or toxoid with the resulting serum being used to counteract the toxin in other individuals.

## **Apoptosis**

or programmed cell death. It is a form of cell death in which the cell activates an internal death program. A series of molecular steps in a cell lead to its death. The cell remains are phagocytosed. This is one method the body uses to get rid of unneeded or abnormal cells. The process of apoptosis may be blocked in cancer cells. Apoptosis contrasts with necrosis, death caused by external factors, which occurs in situations such as poisoning and anoxia.

## **Arthus reaction**

Arthus reaction is a localized type III. hypersensitivity, which results from acute immune complex vasculitis causing tissue necrosis. This is a skin reaction in which antigen is injected into dermis and reacts with IgG antibodies in the extracellular spaces, activating complement and phagocytic cells to produce a local edematous inflammatory lesion.

## **Asthma bronchiale**

Asthma is a chronic disease in which the bronchial airways become narrowed and swollen, making it difficult to breathe accompanied especially by wheezing, coughing, tightness in the chest, shortness of breath and rapid breathing. An asthma attack may be triggered by hyperreactivity to various stimuli, such as allergens, smoke, exercise, stress or rapid change in air temperature.

## **Atopic allergy (atopy)**

Atopy is the increased tendency seen in some people to produce immediate hypersensitivity reactions – type I. hypersensitivity (mediated by IgE antibodies) against innocuous substances.

## **Autoantibodies**

are antibodies specific for self-antigens. An autoantibody is an antibody made against substances formed by a person's own body. Autoantibodies can directly destroy cells that have these substances on them or can make it easier for other white blood cells to destroy them. Some autoimmune diseases are caused by autoantibodies.

## **Autograft**

A graft of tissue transferred from one part of an individual to another part on that same individual is called autograft.



### **Autoimmunity**

Diseases in which the pathology is caused by adaptive immune responses to self-antigens are called autoimmune diseases. Self-antigens to which the immune system makes a response are called autoantigens. Antibodies specific for self-antigens are called autoantibodies. Several mechanisms are used to control and eliminate cells that are potentially self-reactive. The failure of these mechanisms to inactivate self-reactive cells leads to autoimmunity and can affect many organs and tissues of the body.

### **Avidity**

Avidity is the total strength of binding of two molecules or cells to one another at multiple sites. It is distinct from affinity, which is the strength of binding of one site on a molecule to its ligand. The term avidity is often used to describe the collective affinity of multiple binding sites of an immunoglobulin. For example, the IgM antibody is a pentamer and has 10 binding sites. It can, therefore, bind antigens with very high avidity, although the affinity of the individual binding sites is low.

# B

## Basophilia

Basophilia is an abnormal increase in the number of basophils in the blood, occurring in some types of leukaemia, severe anaemia and other disorders.

## Basophilic

Stained with pH basic dyes.

## Basophils

Immune cells of the myeloid lineage – polymorphonuclear leukocytes with cytoplasmic granules. Basophil is a type of white blood cells and a type of granulocytes. Enzymes and inflammatory mediators (such as histamine, heparin...) are released from granules during allergic reactions and asthma. These vasoactive amines can cause smooth muscle contraction. They have surface IgE receptors and are associated with allergic reactions. They don't phagocyte.

## B cells

See B lymphocytes

## BCG

BCG is a weakened strain of the *Mycobacterium bovis* (bacillus Calmette-Guérin) that does not cause disease. BCG is used in a solution to stimulate the immune system in the treatment of bladder cancer and as a vaccine to prevent tuberculosis.

## BCG solution

It is a type of biological therapy used to treat early-stage bladder cancer. The solution is made from a weakened form of a *Mycobacterium bovis* (BCG) that does not cause infection. BCG solution is given into the bladder through a catheter where the solution is held for about two hours. This solution can help the immune system of the patient with bladder cancer kill cancer cells.

## BCR receptors

B cell receptors (BCRs) are newly-generated in the lymphocytes of each individual through random somatic chromosomal rearrangements and mutations. The BCR is composed of membrane immunoglobulin – a structure of four (in the case of IgD) or five (IgM) immunoglobulin domains in the heavy chain linked by a hinge and a short intracellular domain. Membrane immunoglobulin itself does not contain any signalling motifs but instead is linked to the Ig $\alpha$ /Ig $\beta$  heterodimer, which contains activation motifs.

B cell activation is triggered by the binding of antigen to the BCR, the specialized cytoplasmic tails of Ig $\alpha$  and Ig $\beta$  initiate a cascade of intracellular signalling leading to B cell activation and differentiation into plasma cells that secrete immunoglobulins with the same specificity as their BCR. BCRs belong to somatically generated receptors.

### **Bence Jones protein**

A small protein made by plasma cells. It is found in the urine of patients with multiple myeloma (a type of chronic kidney disease)– cancer that begins in plasma cells, probably as a result of the high concentration of Bence Jones proteins in the kidney tubules. This frequently is the ultimate cause of death of these patients.

### **Biogenic amines**

Biogenic amines are low molecular weight organic nitrogen compounds. They are formed by the decarboxylation of amino acids or by amination and transamination of aldehydes and ketones during normal metabolic processes in living cells. Biogenic amines, having several critical biological roles in the body, have essential physiological functions such as the regulation of growth and blood pressure and control of the nerve conduction. They are required in the immunologic system. They are compounds created as the growth regulation (spermine, spermidine, and cadaverine), neural transmission (serotonin), and inflammation mediators (histamine and tyramine).

### **Biological treatment**

A type of treatment that uses substances made from living organisms to treat disease. These substances may occur naturally in the body or may be made in the laboratory. Some biological therapies stimulate or suppress the immune system to help the body fight cancer, infection, and other diseases. Other biological therapies attack specific cancer cells, which may help keep them from growing or kill them. They may also lessen certain side effects of some cancer therapies. Types of biological therapy include immunotherapy (such as vaccines, cytokines, and some antibodies), gene therapy, and some targeted therapies. Also called biological response modifier therapy, biotherapy.

### **Blast transformation**

Also called a blast crisis. A phase of chronic myelogenous leukaemia in which tiredness, fever, and an enlarged spleen occur during the blastic phase when more than 30 % of the cells in the blood or bone marrow are blast cells – immature blood cells.

### **Blotting**

Blotting is a method of transferring proteins, DNA or RNA onto a nitrocellulose, polyvinylidene fluoride or nylon membrane. In Western blotting, a mixture of proteins is separated, usually by gel electrophoresis and transferred by blotting to a nitrocellulose membrane and this blot is used especially for the detection of specific antibodies. Southern blot consists of a nitrocellulose or nylon sheet containing spots of DNA for identification by a suitable molecular probe. Northern blot contains spots of RNA.

### **B lymphocytes – B cells**

B lymphocytes belong to agranular mononuclear leukocytes with single round or oval nucleus and a thin seam of hell blue cytoplasm. They are derived from the lymphoid lineage and are responsible for adaptive immune responses. They are mainly in the lymph nodes throughout the body or circulate in the blood. B lymphocytes mature in the bone marrow and are responsible for the humoral part of the immune response. Some activated B lymphocytes upon maturation differentiate into plasma cells, which secrete immunoglobulins. The epitope specificity of the immunoglobulins secreted by plasma cells is the same as the surface immunoglobulin of the B cell from which it differentiated. Some activated B lymphocytes differentiate into memory cells.

### **Bradykinin**

Bradykinin is a vasoactive peptide that is formed locally in injured tissue. It acts in vasodilation of small arterioles and plays a role in inflammatory processes. Bradykinin also causes a lowering of the blood pressure and contraction of smooth muscle in the bronchus – bronchoconstriction.

### **Bronchoconstriction**

It is the constriction of the airways in the lungs due to the tightening of surrounding smooth muscle. The most common causes are asthma, allergies, chronic obstructive pulmonary disease (COPD) and cystic fibrosis.

### **Bruton's disease**

Bruton's disease (primary immunodeficiency – X-linked agammaglobulinemia) is a genetic disorder in which no mature B cells or antibodies are formed. It is one of the best-known B cell immunodeficiencies. B cells are few in number, and all immunoglobulin isotypes are decreased. Patients have increased susceptibility to infection caused by encapsulated bacteria (e.g., *Haemophilus influenzae*, *Streptococcus pneumoniae* ...).

### **Bursa of Fabricius**

A lymphoid gland in birds and the site of B cell maturation. In mammals, the bone marrow performs this function.



## Cardiolipin

Cardiolipin is the phospholipid, which is used as an antigen in the non-treponemal serological test for syphilis, and it is derived from beef heart. Anti-cardiolipin antibodies are antibodies often directed against cardiolipin and found in several diseases, including syphilis, antiphospholipid syndrome, systemic lupus erythematosus, etc. Cardiolipin is used as the antigen in a serodiagnostic flocculation test for syphilis referred to as the RPR (Rapid Plasma Reagin test). Cardiolipin, together with lecithin and cholesterol, is used as the antigen in the VDRL (Venereal Disease Research Laboratory test).

## CD markers (cluster of designation)

Cells of the immune system are characterised by the presence of membrane differentiation antigens (glycoprotein antigens). These appear in the cell membrane during their development and are referred to as CD (Cluster of Designation). A CD marker is a unique molecule or complex of molecules that a cell expresses. These molecules help to differentiate the cell type or subtype, its maturation stage, degree of activation, etc. The name consists of the letters CD and numbers (e.g. CD1, CD2, ...). Some CD markers are specific to certain cells only and can, therefore, be used to more accurately isolate different cell populations.

## CD4 T cells

White blood cells (Th cells – helper) that carry the co-receptor protein CD4 and recognize peptides, which are bound to MHC class II molecules. They are differentiated into CD4 Th1-lymphocytes (that activate macrophages) and CD4 Th2-lymphocytes (that activate B cells responses to the antigen).

## CD8 T cells

White blood cells (Tc - cytotoxic cells) that carry the co-receptor protein CD8 and recognize peptides displayed as peptide:MHC class I molecules on the cell surface. T cells are differentiated into cytotoxic Tc-lymphocytes. These cells are able to identify and kill cells infected primarily with viruses and also many bacterial infections.

## Cell-mediated immunity

A cell-mediated immunity describes an adaptive immune response in which antigen-specific T cells have the main role and is not primarily characterized by the antibody. While the humoral response mainly protects against extracellular pathogens and toxins, the cell-mediated immunity is responsible for detecting and destroying intracellular pathogens, e.g., cells infected with viruses or bacteria.

## Central lymphoid organs

They are also known as the primary lymphoid organs. The two primary lymphoid organs are the thymus and bone marrow. These are organs in which naive lymphocytes develop from bone-marrow precursors. T cells develop in the thymus. B cells develop in the bone marrow. The secondary lymphoid tissue consists of the lymph nodes, spleen and MALT



(mucosal-associated lymphoid tissue). MALT include the tonsils, adenoids, appendix and Peyer's patches in the ileum. Specialised structures of the lymphoid system are the lymphatic vessels that connect most tissues in the body with lymph nodes and eventually with the bloodstream.

### Central tolerance induction

Central tolerance induction is a process by which T cells with receptors that recognize abundant self-antigens in the thymus are anergized or deleted.

### C<sub>H</sub> region

C<sub>H</sub> region is the constant region (domain) of the immunoglobulin heavy chain.

### Chemokines

Chemokines are special cytokines that are used to direct cells to their proper positions. A group of cytokines that have a chemotactic effect, stimulate the movement of leukocytes, have an immunomodulatory effect. These are substances with a low molecular weight that can have different specificities for certain cell types. Chemokines are secreted by leukocytes and other cells and are involved in innate immunity, adaptive immunity, and inflammation.

### Chemotaxis

Chemotaxis is a chemical-induced migration of leukocytes. It is described as the directed migration of cells towards a chemoattractant.

### Chronic GvH disease

Symptoms of chronic GvH disease might include any of the following: rash, raised, or discoloured areas, skin thickening or tightening, abdominal swelling, yellow discolouration of the skin and/or eyes, and abnormal blood test results, dry eyes or vision changes, dry mouth, white patches inside the mouth, pain or sensitivity to spicy foods, shortness of breath or changes are seen on your chest X-ray, difficulty swallowing, pain with swallowing, or weight loss, fatigue, muscle weakness, or pain, vaginal dryness or pain with intercourse, decreased range of motion in joints or tightness in joints.

### C<sub>L</sub> region

C<sub>L</sub> region is the constant region (domain) of the immunoglobulin light chain.

### Clon

A clone is a population of cells all derived from a single progenitor cell.

### Cold antibodies

Antibodies that are effective at lower temperatures (usually 4-20°C) include cold hemolysins, cold hemagglutinins, cryoglobulins.

### Complement

Complement is a set of plasma proteins that act together to attack extracellular forms of pathogens. Complement is involved in non-specific humoral immunity. The individual components are activated gradually in a cascade by classical, alternative or lectin pathways to form a membrane attack complex. The result is lysis of the target cell.



### **Complement-fixation test**

It is a classic immunological method for demonstrating the presence of antibodies in patient serum. It is based on the principle that the antigen-antibody complex fixes the complement. Sheep red blood cells coated with anti-sheep red blood cells antibodies are used as an indicator system. Complement lyses antibody-coated red blood cells. Patient serum is first added to the known antigen, and complement is added to the solution. If the serum contains antibodies to the antigen, the resulting antigen-antibody complexes will bind all of the complement. Positive test (serum with antibody against known antigen): all available complement is fixed by the antigen-antibody reaction; no hemolysis occurs, so the test is positive for the presence of antibodies. Negative test (serum without antibody against known antigen): no antigen-antibody reaction occurs. The complement remains, and the red blood cells are lysed, so the test is negative for the presence of antibodies.

### **Complement receptors**

Complement receptors (CRs) are displayed on phagocytic cells and B cells that allow for recognition of microbes and immune complexes. These cell-surface proteins are on various cells that recognize and bind complement proteins that have bound an antigen (such as pathogen).

### **Conjugate vaccine**

Conjugate vaccine is vaccine made from capsular polysaccharides that are bound to proteins of known immunogenicity.

### **Contact allergic dermatitis (eczema)**

An allergic contact dermatitis is a form of eczema caused by an allergic reaction to an allergen, in contact with the skin. The allergen is harmless to people that are not allergic to it. Allergic contact dermatitis is also called contact allergy, which is a IV. type of hypersensitivity or delayed hypersensitivity reaction and occurs 48–72 hours after exposure to the allergen. The mechanism involves CD4+ T-lymphocytes, which recognise an antigen on the skin surface, releasing cytokines that activate the immune system and cause dermatitis.

### **Corticosteroids**

Corticosteroids are drugs related to steroids that are naturally produced in the adrenal cortex. Corticosteroids are useful anti-inflammatory, anti-allergic and immunosuppressive agents. They are used when it is necessary to suppress the excessive activity of the immune system, which is involved in damaging the body.

### **Co-stimulation**

Co-stimulation is a secondary signal which lymphocytes need on to activate an immune response in the presence of an antigen-presenting cell. During the activation of lymphocytes, co-stimulation is crucial to the development of an effective immune response.

### **Cross-reaction**

In some cases, antibodies targeted to one antigen are able to react with all other antigens carrying the same epitope. For two or more different antigens, it is possible to have the same or similar epitopes. These antigens are called cross-reacting antigens.



### **C-reactive protein (CRP)**

CRP is an acute-phase protein present in blood serum in elevated values in various abnormal states (such as bacterial inflammation, bacterial versus viral infections, necrotizing pancreatitis versus edematous interstitial pancreatitis, pyelonephritis versus cystitis, neoplasia, necrosis, autoimmune diseases, certain chronic inflammatory diseases etc.). CRP binds to phosphorylcholine that is component of the C-polysaccharide of *Streptococcus pneumoniae*. Many other bacteria have surface phosphorylcholine, so CRP can bind many different bacteria and opsonize them for engulfment by phagocytes. The clinical usefulness of quantitative CRP determinations has been demonstrated for various indications. In response to an inflammatory stimulus, a rise of CRP may be detected within 6 to 10 hours.

### **Crossing-over**

Crossing over is the swapping of genetic material that happens during meiosis and results in a shuffling of genetic material and is an important cause of the genetic variation seen among offspring. In this process, a region of one chromosome is exchanged for a region of another chromosome, thereby producing unique chromosomal combinations that further divide into haploid daughter cells.

### **Cross-presentation**

Cross-presentation is a process by which exogenous proteins, which normally should be presented by MHC II molecules, are presented by MHC I molecules.

### **Cross-reaction**

It is the binding of an antibody to an antigen not used to elicit that antibody. Thus, if the antibody raised against antigen „A“ also binds antigen „B“, it is said to cross-react with antigen „B“. The term is used to describe the reactivity of antibodies with antigens other than the eliciting antigen.

### **CRs**

see complement receptors

### **Cryoglobulins**

Antibodies that are effective at lower temperatures (usually 4-20°C) include cold hemolysins, cold hemagglutinins, cold agglutinins. Cryoglobulins are found in a wide spectrum of disorders but are often transient and without clinical implications. Monoclonal cryoglobulins are usually associated with hematological disorders, whereas mixed cryoglobulins are found in many infectious and systemic disorders. Cryoglobulins precipitate in vitro at temperatures below 37°C and redissolve on rewarming.

### **C3 component of complement**

C3 component of complement is a central and key component of all the complement pathways. C3 convertase cleaves C3 into its active form C3a and C3b. Component C3a diffuses away and has important functions in inflammation (can act as anaphylatoxin, can cause degranulation of eosinophils, can activate mast cells, has chemotactic activity). C3b is a very important opsonin. Monocytes, macrophages and neutrophils have receptors for C3b on their surface. Some of C3b binds to C3 convertase forming C5 convertase that cleaves C5 component, which is the last enzymatic step in the complement pathway. The later steps involve a generation of pores in the membrane and lysis of the cell. These pores



are called membrane attack complex. The importance of C3 is demonstrated by the fact that people who lack C3 suffer from recurrent, life-threatening bacterial infections.

### **Cyclosporine A**

Cyclosporine is an immunosuppressive drug that is used especially to prevent rejection of transplanted organs and bone marrow. Cyclosporine has major effects on T cells. It causes the inhibition of the production of cytokines involved in the regulation of T cells (inhibits the transcription of interleukin IL-2).

### **Cytokines**

Cytokines are small proteins made by certain immune and non-immune cells that serve in enabling cells to communicate with each other. They have low molecular weight and regulate immune responses. There are many cytokines and they are divided into families (interleukins, interferons, tumour necrosis factors, colony-stimulating factors, chemokines and growth factors). The action of cytokines is mediated through specific cytokine receptors on the surfaces of target cells.

### **Cytolysin**

Cytolysin is a pore-forming bacterial protein, a substance secreted by microorganisms that is able to lyse bacterial cells.

### **Cytolysis**

Pathologic dissolution or disintegration of cells.

### **Cytotoxic**

Cytotoxic refers to a substance or process which results in cell damage or cell death. This term is often used to describe chemotherapy drugs that kill cancer cells. Some cells of the immune system are considered cytotoxic, such as the T cells that kill bacteria, viruses, and cancer cells.

### **Cytotoxin**

It is a substance that can kill cells. Cytotoxins are proteins made by cytotoxic T cells that participate in the destruction of target cells.

### **Cytotoxic T-lymphocytes (CTL)**

A type of white blood cells that can kill certain cells, including foreign cells, cancer cells, and virus-infected cells.

## D

**Deficiency**

The state of being defective or of lacking some necessary quality or element (e.g. enzymes, one or more components of the immune system, an insufficient function of the cells of the immune system...)

**Denaturation of proteins**

Modification of the molecular structure of proteins especially by heat, acid, alkali, or ultraviolet radiation so as to destroy or diminish some of the original properties and especially the specific biological activity.

**Dendritic cells**

Dendritic Cells (DCs) act as the messenger cells of the immune system by processing antigens from pathogens and presenting the antigens to T cells to initiate an immune response.

**Delayed-type hypersensitivity**

Or type IV hypersensitivity is a form of cell-mediated immunity elicited by an antigen in the skin and is mediated by CD4 Th1-lymphocytes. It is called delayed-type hypersensitivity because the reaction appears hours to days after antigen is injected (24-72 hours). These responses are often generated against pathogens that can live inside macrophages themselves. The aims of delayed-type hypersensitivity response are to recruit monocytes to the site of infection, to keep monocytes and tissue macrophages at the site of infection and to activate the monocytes and macrophages to kill the intracellular organisms.

**Deoxyribonuclease (DNase)**

DNase is one type of nuclease, an enzyme capable of hydrolyzing phosphodiester bonds that link nucleotides in the DNA backbone, thus degrading DNA.

**Dermatomyositis/polymyositis**

Dermatomyositis and polymyositis are connective tissue diseases which are of uncertain aetiology. They are autoimmune diseases which primarily affect the skin and/or the muscles, although other organs may also be involved (lung and heart). The course of dermatomyositis and polymyositis can vary from mild to severe forms which may lead to various complications with poor prognosis, like the development of the interstitial pulmonary disease. The illnesses severely affect the quality of life and may, if not diagnosed and treated rapidly, progress over time to a life-threatening state.

**Diapedesis**

Diapedesis is the passage of blood cells (especially leukocytes) through unruptured capillary walls into the tissues.

## Diffusion

Diffusion is the movement of particles through a semipermeable barrier from a region of higher concentration to a region of lower concentration down the concentration gradient.

## DiGeorge's syndrome

DiGeorge's syndrome (also known as 22q11.2 deletion syndrome) is a recessive genetic immunodeficiency disease. There is a failure to develop thymic epithelium. It is also associated with absent parathyroid glands and large vessel anomalies due to a developmental defect in neural crest cells. The severity of the effects of DiGeorges's syndrome is variable. The syndrome may include malformations of the aorta, the face and jaw. Signs and symptoms can vary in type and severity, depending on what body systems are affected and how severe the defects are. Some signs and symptoms may be apparent at birth, but others may not appear until later in infancy or early childhood. Individuals with DiGeorges's syndrome have increased susceptibility to infections, significant deficiency in the number of functional T cells and variable immunoglobulin levels.

## Diphtheria antitoxin

Diphtheria toxin-neutralizing antibody (antitoxin). Diphtheria antitoxin is used to treat and prevent diphtheria, an often deadly childhood disease. Scientists grow diphtheria-causing bacteria in the laboratory and harvest its toxin. Then this diphtheria toxin is injected to horses. The animals produce diphtheria antitoxin as an immune response. Blood from the horses is collected and scientists separate the antitoxin rich serum, which is purified for use as a medicine for people.

## Diphtheria toxin

*Corynebacterium diphtheriae* can produce exotoxin called diphtheria toxin. It is encoded by a lysogenic bacteriophage and has neurotoxic and cardiac effects. Diphtheria toxin is produced locally and spread by the bloodstream to different organs, with a high affinity for the heart muscle, the peripheral nervous system and adrenal glands. It is a heat-stable polypeptide and has two fragments: A and B. The subunit A is an active fragment, which is responsible for inhibition of protein synthesis, and probably responsible for the necrotic and neurotoxic effects of the toxin. The subunit B is responsible for binding on susceptible cells.

## DNA denaturation

DNA denaturation refers to the melting of double-stranded DNA to generate two single strands.

## DNA polymerase

A thermostable enzyme catalyzes the formation of DNA from precursor substances in the presence of preexisting DNA acting as a template. DNA polymerase from the thermophilic bacterium *Thermus aquaticus* is used in the polymerase chain reaction (PCR).

## DNA primer

DNA primer is a short single-stranded DNA whose presence is required for the formation of a long chain of DNA. DNA primers contain approximately 20 base pairs. PCR uses small DNA primers that bind to complementary regions of the target nucleic acid sequence.

### **DNA replication**

DNA replication is a biological process in which two identical DNA molecules are formed from one original DNA molecule.

### **DNA vaccine**

DNA vaccines are the newest type of vaccines. The field of DNA vaccination is developing rapidly. Vaccines currently being developed use not only DNA encoding an antigen of interest, but also include adjuncts that assist DNA in entering cells, target it towards specific cells, or that may act as adjuvants in stimulating or directing the immune response. Many aspects of the immune response generated by DNA vaccines are not understood. However, this has not impeded significant progress towards the use of this type of vaccine in humans, and clinical trials have begun.

### **Down syndrome**

Down syndrome (also called trisomy 21) is a genetic disorder caused when abnormal cell division results in an extra full or partial copy of the human chromosome numbered 21. Down syndrome is characterized by developmental delays and physical features, usually variable in severity among individuals. It causes mild to moderate impairment in cognitive functioning, learning disabilities in children. It also commonly causes other medical abnormalities, including heart and gastrointestinal disorders, short stature, upward slanting eyes, a flattened nasal bridge, broad hands with short fingers, decreased muscle tone.

### **Dysgammaglobulinemia**

Dysgammaglobulinemia is an immunologic deficiency state characterized by selective deficiencies of one or more, but not all, classes of immunoglobulins.

# E

## **Eczema**

An eczema is a group of disease that results in inflammation of the skin. It is a condition that causes inflamed, dry, itchy, cracked, and rough skin. The most common form of eczema is atopic dermatitis. It is common in children but can occur at any age.

## **EIA (Enzyme ImmunoAssay)**

Enzyme immunoassay is a serological method in which antigen (or antibody) is detected by a linked enzyme that converts a colourless substrate into a coloured product. EIA is a test that detects antibodies usually. It is used to determine if the patient has antibodies related to certain infectious diseases.

## **Electrophoresis**

Electrophoresis is a general term that describes the migration and separation of charged particles under the influence of an electric field based on their size and electrical charge. An electrophoretic system consists of two electrodes of opposite charge (anode, cathode), connected by a conducting medium called an electrolyte. Electrophoresis may be defined as the migration of charged ions in an electric field. In metal conductors, electric current flows between electrodes and is carried by ions. The negative electrode - the cathode - donates electrons and the positive electrode - the anode - takes up electrons to complete the circuit.

## **ELISA (Enzyme-Linked ImmunoSorbent Assay)**

ELISA is a serological method. This method is a direct binding assay for antibody (or antigen) *in vitro* and is frequently used in viral and bacterial diagnostics. Bound antibody (or antigen) is detected by a linked enzyme that converts a colourless substrate into a coloured product. The unlabeled component, which in this case would be an antigen, is attached to a solid support, such as the wells of a plastic multiwell plate, which will adsorb an antibody. The detected antibody is allowed to bind to the antigen, and any unbound antibody and other proteins are washed away. Antibody binding in ELISA is detected by a reaction that converts a colourless substrate into a coloured reaction product.

## **Elongation in DNA replication**

During elongation, an enzyme DNA polymerase adds DNA nucleotides to the 3' end of the newly synthesized polynucleotide strand. The template strand specifies which of the four DNA nucleotides (A, T, C, or G) is added at each position along the new chain. Only the nucleotide complementary to the template nucleotide at that position is added to the new strand.

## **Elongation of RNA strand**

Elongation is the stage when the RNA strand gets longer, thanks to the addition of new nucleotides. During elongation RNA polymerase always builds a new RNA strand in the 5' to 3' direction. That is, it can only add RNA nucleotides (A, U, C, or G) to the 3' end of the strand.

## Endemic

Endemic refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.

## Endocytosis

Endocytosis is a process of taking a particle or substance from outside of the cell and transferring it inside the cell using a vesicle. Endocytosis occurs when a portion of the cell membrane folds in on itself, encircling extracellular fluid and various molecules or microorganisms. The resulting vesicle (endosome) breaks off and is transported within the cell. There are two types of endocytosis: phagocytosis and pinocytosis. Phagocytosis, also known as cell eating, is the process by which cells internalize large particles or cells, like damaged cells and bacteria. Pinocytosis, also known as cell drinking, is common in plant and animal cells. During pinocytosis, the cell takes in substances from the extracellular fluid that it needs to function. These include things like water and nutrients.

## Endosome

Endosome or phagosome is an organelle within the cell. The ingested foreign particle is surrounded by the cell membrane, which is then invaginated. An endosome or phagosome is created. The phagosome fuses with a lysosome to form a phagolysosome, in which the ingested material is killed and digested by enzymes.

## Endotoxin

Bacterial endotoxins are found in the outer membrane of gram-negative bacteria. Endotoxins are members of a class of phospholipids called lipopolysaccharides. Lipopolysaccharides are not exogenous products of gram-negative bacteria. Their release from bacteria takes place after death and lysis of the cell. Good examples of pyrogen producing gram-negative bacteria are *Escherichia coli*, *Proteus*, *Pseudomonas*, *Enterobacter* and *Klebsiella*. Endotoxins have a large spectrum of biological activities including pyrogenicity, leukopenia, leukocytosis, complement activation, depression of blood pressure. Platelet aggregation and lethal shock are also examples of classical endotoxic activities.

## Enzyme Immunoassay

Enzyme immunoassay is a bioanalytical method in which the quantitation of the analyte depends on the reaction of an antigen (analyte) and an antibody. Principally, these methods are based on a competitive binding reaction between a fixed amount of labelled form of an analyte and a variable amount of unlabelled sample analyte for a limited amount of binding sites on a highly specific anti-analyte antibody. When these immunoanalytical reagents are mixed and incubated, the analyte is bound to the antibody-forming an immune complex. This complex is separated from the unbound reagent fraction by physical or chemical separation technique. The analysis is achieved by measuring the label activity (e.g. enzyme) in either of the bound or free fraction. A standard curve is constructed. It represents the measured signal as a function of the concentration of the unlabelled analyte in the sample. The unknown analyte concentration is determined from this calibration curve.

## Eosinophil

Eosinophils are cells of the immune system originating from the myeloid lineage. They are polymorphonuclear leukocytes and granulocytes with characteristic bi-lobed nucleus and granules in the cytoplasm. Their granules are stained with pH acidic dyes and have a red colour.

They are present in the blood of normal individuals at very low levels (<4% of the leukocytes). Healthy people have several hundred eosinophils in a drop of blood. In the cytoplasm, they have about 200 granules containing specialized proteins: the main basic protein, the eosinophilic cationic protein, the eosinophil peroxidase ..., which have a toxic effect on parasites (mainly worms) and tumour cells. Eosinophils have receptors for IgE and for components of complement.

They are very often involved in allergic responses and also play a role in chronic inflammation. Their ability to phagocytose is weak. However, upon activation, the active metabolites are released from the granules, prostaglandins, cytokines and leukotrienes, which damage the surface of the parasite. The number of eosinophils is increased in parasitic infection, which is one of the laboratory diagnostic features. On the cell membrane of eosinophils, there are receptors for immunoglobulins IgE and complement components. They play an important role in allergic reactions as well as in chronic inflammation.

## Eosinophilia

Eosinophilia is a condition of having an increased number of eosinophils in the peripheral blood and is defined as a peripheral blood eosinophil count  $> 500/\text{mcL}$  ( $> 0.5 \times 10^9/\text{L}$ ). Eosinophilia occurs when a large number of eosinophils are recruited to a specific site in the body or when the bone marrow produces too many eosinophils. Variety factors can cause eosinophilia: parasitic and fungal diseases, allergic reactions, skin disorders, toxins, autoimmune disease, tumours. Most common causes of eosinophilia are parasitic diseases and allergic reactions.

## Epidemic

Epidemic refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.

## Epitop

Also called antigenic determinant, a portion of a foreign antigen, that is capable of stimulating an immune response. An epitop is the part of the antigen that binds to a specific antigen receptor on the surface of a B cell. Binding between the receptor and epitope occurs only if their structures are complementary (like a puzzle) that is necessary to activate B cell production of antibodies. These antibodies are essentially identical to the receptor of the B cell that produced it. Antibodies are targeted specifically to the epitope. Many antigens have a variety of distinct epitopes on their surface, which are capable of reacting with different B cell receptors.

## Eukaryotic cells

Eukaryotic cells are cells that contain a nucleus and organelles and are enclosed by a plasma membrane. Eukaryotic cells have a nuclear membrane that surrounds the nucleus, in which the well-defined chromosomes (containing the hereditary material) are located. Organisms that have eukaryotic cells include protozoa, fungi, plants and animals.

## Exocytosis

Exocytosis is a process that is used to transport material from inside the cell to the external part of the cell by the use of energy. It is a type of active transport mechanism, which is the opposite of endocytosis. In this mechanism of exocytosis, a special vesicle bound to the cell membrane, containing the cellular particles will expel the cell content to the external part of the cell. This mechanism has been used in the removal of waste materials from the cell, transport proteins, for chemical signalling between cells.

## Exotoxin

Exotoxins are diffusible proteins secreted into the external medium by the pathogen. They are usually heat-labile proteins secreted by certain bacterial species, most often by gram-positive microorganisms (e.g. toxins of *Corynebacterium diphtheriae*, *Clostridium tetani*, *Clostridium botulinum*, *Staphylococcus aureus*, *Streptococcus pyogenes*). However, some of the exotoxins are listed in gram-negative bacteria (e.g. cholera toxin, *Escherichia coli* enterotoxin, *Shigella* toxin, *Bordetella pertussis* exotoxins).

Exotoxins are often classified by their mode of action: type I toxins (super-antigenic toxins) that bind surface receptors and stimulate transmembrane signals. Type II toxins that affect membranes and form pores or cause disruption lipid layers of the membranes. Type III toxins (A-B toxins) are intracellular effectors that translocate an active enzymatic fragment into the cell. One subunit of the toxin is responsible for binding, and next subunit has biological activity. Exotoxins are important virulence factors.

## Extractable Nuclear Antigens (ENA)

Extractable nuclear antigens are soluble in physiological buffers and are considered as significant autoimmune markers. The most common anti-ENA antibodies include anti-Sm, RNP, Jo-1, Scl-70 PM-Scl. They are mainly recognized in sera from patients with systemic lupus erythematosus, polymyositis, dermatomyositis, scleroderma, Sjogren's syndrome, mixed connective tissue diseases (Sharp syndrome).

## Extrinsic

Coming from outside, e.g. extrinsic asthma is caused by an allergic reaction in which symptoms are triggered by an allergen such as dust mites, pollen, moulds, pet dander, etc.

# F

## **Fab fragment (Fragment antigen binding)**

Fab is **F**ragment with the specific **antigen-binding** site of immunoglobulin. This fragment consists of the light chain and the amino-terminal part of the heavy chain that held together by a disulfide bond. Each monomer of immunoglobulin has two Fab fragments, which are localized in the variable region of an immunoglobulin.

## **F(ab)<sub>2</sub> fragment**

Region of an immunoglobulin, which has two Fab fragments held together by an interchain disulfide bond.

## **Fc fragment**

The Fc fragment consists of the carboxy-terminal halves of the two heavy chains. Fc fragment is localized in the constant region of an immunoglobulin. Fc fragment is not an antigen-binding site. Cell surface receptors recognize the Fc fragments of some immunoglobulins on basophils, eosinophils and mast cells, that localize these antibodies to their surface.

## **Fc receptor (FcR)**

Fc receptor binds the Fc fragment of immunoglobulin isotypes. There are two types: Fc $\epsilon$  receptors on the surface of basophils, eosinophils, mast cells, and Fc $\gamma$  receptors on the surface of macrophages, B lymphocytes, NK cells, follicular dendritic cells.

## **Fibronectin**

Fibronectin is a multifunctional adhesive glycoprotein that plays an important role in tissue repair, in regulating cell attachment and motility, and in embryogenesis. Fibronectin exists in two forms, circulating and tissue. The liver synthesizes most of the fibronectin found in the plasma. Fibroblasts, endothelial cells and other cell types synthesize tissue fibronectin.

## **Flow cytometry**

Flow cytometry represents the gold standard for the determination of cell populations. Flow – cells in motion, Cyto – cell, Metry – measure: is a standard method for analyzing a single cell population. It is a sophisticated device measuring multiple physical characteristics of a single cell such as size and granularity simultaneously as the cell flows in suspension through a measuring apparatus. Its working depends on the light scattering features of the cells under investigation, which may be derived from several dyes or monoclonal antibodies targeting either extracellular molecules or intracellular molecules.

## **Follicular dendritic cells**

Follicular dendritic cells are unique immune cells that contribute to the regulation of humoral immune responses. These cells are located in the B cell follicles of secondary lymphoid tissues where they trap and retain antigens in the form of highly immunogenic immune complexes consisting of antigens plus specific antibodies and/or complement proteins.



### **FTA test**

The **F**luorescent **T**reponemal **A**ntibody absorption test is a diagnostic test for *Treponema pallidum*, which is the etiological agent of syphilis.

## G

**GALT – gut-associated lymphoid tissue**

GALT is a part of the mucosa-associated lymphoid tissue which protect the body from invasion in the gut. GALT includes Peyer's patches, the appendix and scattered solitary or isolated lymphoid follicles.

**Gamma-globulins**

Gamma-globulin is a protein fraction of blood rich in antibodies. Gamma globulins have important biological functions. Persons who lack gamma-globulin or who have an inadequate supply of it (agammaglobulinemia or hypogammaglobulinemia) have frequently recurring infections because of their inability to develop adequate immunity to infectious diseases.

**Germinal centre**

Germinal centre is a secondary lymphoid follicle. It is an area in secondary lymphoid organ in which B cells proliferate and undergo somatic mutation, and switch class.

**Glucocorticoids**

Glucocorticoids are steroid hormones produced by the adrenal cortex. They have an anti-inflammatory and immunosuppressive effect and are used widely in medicine to treat inflammatory bowel disease, systemic lupus erythematosus, autoimmune hemolytic anaemia, rheumatoid arthritis etc. They may be naturally produced (hormones) or synthetic (drugs).

**Glucose-6-phosphate dehydrogenase deficiency**

An inherited disorder in which a patient doesn't have enough of an enzyme called G6PD that helps red blood cells work the way they should. In this deficiency, the red blood cells break down when the body is exposed to infection, severe stress, or certain drugs, chemicals or foods. This may lead to a condition called haemolytic anaemia.

**GM-CSF**

Granulocyte-macrophage colony-stimulating factor is a cytokine that helps make more white blood cells, especially granulocytes, macrophages and cells that become platelets.

**Goodpasture syndrome**

Goodpasture syndrome is a rare disorder in which the body mistakenly makes antibodies that attack the lungs and kidneys. It is an autoimmune disorder. Goodpasture syndrome refers to an anti-glomerular basement membrane disease that involves both the lungs and kidneys, often presenting as pulmonary haemorrhage and glomerulonephritis. Physiologically, the immune system creates antibodies to fight off microorganisms. But with Goodpasture syndrome, the immune system mistakenly makes antibodies that attack the lungs and kidneys. This condition can quickly progress to an inflammation of the kidneys (glomerulonephritis) and kidney failure. It can be fatal if not quickly diagnosed and treated. Goodpasture syndrome most often occurs in people ages 20 to 30 or people older than age 60. In some cases, bleeding in the lungs may occur. In most cases, this

disease does not cause lasting damage to the lungs. But kidney damage may be long-lasting. Treatment may include immunosuppressive medicines, antibiotics, corticosteroids, plasmapheresis. If the kidneys fail, kidney transplant or dialysis may be needed.

### **Graft**

Healthy skin, bone or other tissue is taken from one part of the body and used to replace diseased or injured tissue removed from another part of the body.

### **Granulocyte**

Granular leukocyte is a type of immune cell that has segmented nucleus and granules with enzymes that are released during infections, allergic reactions and asthma. Granulocytes are neutrophils, eosinophils and basophils. They are also called polymorphonuclear leukocytes.

### **Granulocytopenia**

It is a condition in which there is a lower than the normal number of granulocytes.

### **Granzyme**

Granzymes are serine proteases released by cytoplasmic granules within cytotoxic T-cells and NK cells. They induce cell death in the target cell, lead to apoptosis and eliminate cells that have become cancerous or are infected with viruses or bacteria. Granzymes kill the bacteria and inhibit viral replication.

### **Graves-Basedow disease**

Graves-Basedow disease is an autoimmune disorder that causes hyperthyroidism or overactive thyroid. With this disease, the immune system attacks the thyroid and causes it to make more thyroid hormone than the body needs. The presence of thyroid-stimulating antibodies may lead to hyperthyroidism, thyroid orbitopathy and thyroid dermopathy. The development of Graves-Basedow disease is dependent on the presence of two or three groups of factors - genetic and environmental or genetic, environmental and endogenous factors.

### **Growth factors**

Growth factors are molecules that can induce a proliferation of multiple cells. These factors facilitate the growth of cells. Examples include G-CSF (granulocyte colony-stimulating factor), GM-CSF (granulocyte-macrophage colony-stimulating factor).

### **GvH (graft versus host) disease**

A disease caused when cells from a donated stem cell graft attack the normal tissue of the transplant patient. Symptoms include jaundice, skin rash or blisters, a dry mouth, dry eyes etc. In graft vs. host disease (GvH), the donated bone marrow or stem cells view the recipient's body as foreign, and the donated cells/bone marrow attack the body. The two types of GvH disease are acute and chronic.

## H

**HAE – hereditary angioneurotic edema**

Hereditary angioneurotic oedema is a genetic deficiency of the C1 inhibitor of the complement system. In the absence of this inhibitor, spontaneous activation of the complement system leads to diffuse fluid leakage from blood vessels. The swelling most commonly affects the face, arms, legs, airway and gastrointestinal tract. Usually, it is not itchy. The swelling usually lasts 24 hours to 72 hours. If they affect vital organs, they can endanger the patient's life (swelling of the airway can result in its obstruction).

**H chain**

Heavy chain (H chain) is the chain of immunoglobulin. Each immunoglobulin monomer consists of two identical heavy chains ( $\mu$ ,  $\gamma$ ,  $\alpha$ ,  $\epsilon$  or  $\delta$ ) and two identical light chains ( $\kappa$  or  $\lambda$ ) that held together by a disulfide bond. Heavy chains have a variety of heavy-chain classes or isotypes ( $\mu$ ,  $\gamma$ ,  $\alpha$ ,  $\epsilon$  or  $\delta$ ). Each isotype (IgM, IgG, IgA, IgE, IgD) has a distinctive functional activity. Heavy chain consists of one V (variable) domain and 3 or 4 C (constant) domains. Each heavy chain of the immunoglobulins IgG and IgA has three C domains and heavy chain of immunoglobulins IgM, IgE and IgD has four C domains.

**Hapten**

Hapten is small molecule that stimulates the production of antibody only when conjugated to a larger molecule that is called a carrier, most often a protein. Hapten-carrier complex stimulates the production of antibodies and becomes immunogenic. Without carrier molecule hapten is not immunogenic. A hapten is essentially an incomplete antigen. Although the unbound hapten cannot elicit an antibody response on its own, it can bind with antibodies and acts as an antigen; the carrier typically does not elicit an immune response by itself.

**Hashimoto disease**

Hashimoto's thyroiditis is an autoimmune disease characterized by persistently high levels of antibodies against thyroid antigens. Antibodies against thyroid peroxidase can be detected in the sera of most patients with chronic autoimmune thyroiditis, and in some patients also anti-thyroglobulin antibodies are detected. The thyroid peroxidase is an enzyme that plays a role in the production of thyroid hormones. If Hashimoto's thyroiditis causes cell damage leading to low thyroid hormone levels, patients will eventually develop symptoms of hypothyroidism. Hypothyroid symptoms may include fatigue, weight gain, constipation, increased sensitivity to cold, dry skin, depression, muscle aches and reduced exercise tolerance, and irregular or heavy menses. In some cases, the inflammation causes the thyroid to become enlarged (goitre), which rarely may cause neck discomfort or difficulty swallowing.

**Helper T cells**

Helper T cells are CD4 T cells that are able to recognise antigenic peptides presented by class II MHC on the surface of a cell. Two major types of helper T cells have been

identified, called Th1 and Th2, which secrete different patterns of cytokines and therefore have different regulatory functions.

### **Hemagglutination**

1. Hemagglutination is a serologic assay that is used either to detect antibodies to a microorganism or to identify a suspect microorganism. Hemagglutination is visible macroscopically and is the basis of hemagglutination tests to detect the presence of viral or bacterial particles. A haemagglutinin is any substance that causes red blood cells to agglutinate, which is known as haemagglutination. The haemagglutinins in human blood are antibodies that recognize the ABO group antigens in the blood.

2. Hemagglutination is a serological agglutination method in which an antigen is bound to the surface of erythrocytes, antibodies against this antigen are proved by their aggregation (agglutination). In hemagglutination, erythrocytes serve as antigen carriers and at the same time as indicators of the reaction.

### **Hemagglutination-inhibition test**

Certain viruses have the property of attaching to specific receptors on the surface of appropriate red blood cells. This test is based on the property that a virus will bind to erythrocytes (red blood cells) and will cause the formation of a lattice. This property is called hemagglutination, and is the basis of a rapid assay to determine the level of virus present in a sample. A virus is mixed with a specific amount of erythrocytes. Erythrocytes that are not bound by virus sink to the bottom of a microplastic well and form a button. The red blood cells that are attached to the viral particles form a lattice that coats the well. The basis of the hemagglutination-inhibition test is that antibodies to a virus will prevent attachment of the virus erythrocytes. Therefore hemagglutination is inhibited when antibodies are present. The highest dilution of serum that prevents hemagglutination is called the haemagglutination-inhibition titer of the serum. If the serum contains no antibodies against the virus, then hemagglutination will be observed in all wells. Likewise, if antibodies to the virus are present, hemagglutination will not be observed until the antibodies are sufficiently diluted.

It is used in the serological diagnosis of diseases caused by hemagglutinating viruses, influenza, parainfluenza, rubella, measles, etc. (antibodies added to the virus suspension are able to prevent hemagglutination).

### **Hematopoiesis**

Hematopoiesis is the generation of the cells of the blood, including the red blood cells, leukocytes, and platelets. All these cells originate from pluripotent hematopoietic stem cells. The process of haematopoiesis occurs in the bone marrow, and two major cell lines are differentiated, lymphoid and myeloid line. From common lymphoid progenitor are differentiated T-cells, B cells and NK cells. From common myeloid progenitor are differentiated granulocytes, monocytes, erythrocytes and thrombocytes.

### **Hemolysis**

Hemolysis is the destruction of red blood cells due to different causes and leads to the release of hemoglobin into the bloodstream. Erythrocytes have a lifespan of about 120 days. After they die they break down and are removed from the circulation by the spleen. In some conditions, this breakdown of erythrocytes is increased. Hemolytic anemia is the term used to refer to anemia caused by the excessive destruction of red blood cells.

### **Hemolytic unit (CH50)**

A CH50 test is used to help determine any protein abnormalities and deficiencies in the complement system. Values are reported in hemolytic units. One hemolytic unit determines the amount of complement that is able to lyse 50% of the standard concentration of sensitized sheep erythrocytes. CH50 blood test is a screening test sensitive to inactivity, absence or reduction of any component of the complement system. If the complement components are absent, the CH50 level will be zero; if one or more components of the classical pathway are decreased, the CH50 will be decreased. The total complement activity, or CH50 blood test, assesses the overall activity of the complement system, and mainly evaluates the classic complement activation pathway.

### **Herd immunity**

Herd immunity, also known as population immunity, is a form of protection from certain infectious disease that occurs when a majority of a population are vaccinated, lowering the overall amount of microorganisms able to spread in the whole population. As a result, not every single person needs to be vaccinated to be protected, which helps ensure vulnerable groups who cannot get vaccinated are kept safe. The percentage of people who need to have antibodies in order to achieve herd immunity against a particular disease varies with each disease. For example, herd immunity against measles requires about 95% of a population to be vaccinated. The remaining 5% will be protected by the fact that measles will not spread among those who are vaccinated.

### **Heterologous**

The heterologous definition is derived from a different species. It is the opposite of homologous. For example, a heterologous serum is serum obtained from a different animal species (than that administered) after immunization of that animal species with a particular antigen. It is used, e.g. for passive immunization (horse serum is often used in medicine).

### **Heterophile antibodies**

Heterophile antibodies, originally described by Paul and Bunnell, are present in 90% to 95% of EBV infections at some point during the illness. However, in infants and children under the age of 4 years with primary EBV infection, heterophile antibody responses are often not detected. Heterophile antibodies are IgM antibodies, which agglutinate erythrocytes from different species, including bovine, camel, horse, goat, and sheep.

### **Hexavalent vaccine**

A vaccine against six pathogens simultaneously. It is a combination vaccine with six individual vaccines conjugated into one and is used in pediatrics. It is indicated for diphtheria, tetanus, pertussis, hepatitis B, poliomyelitis and *Haemophilus influenzae* type b.

### **Histamine**

Histamine is a biologically active substance found in a variety of organisms. In humans, the vasoactive amine is found in nearly all tissues of the body, where it is stored primarily in the granules of tissue mast cells. Basophils also harbour histamine in their granules. Histamine released by antigen binding to IgE molecules on mast cells causes many varied effects within the body, including the dilation of local blood vessels, which increases permeability and lowers blood pressure; smooth muscle contraction; and symptoms of immediate hypersensitivity reactions.

### **HLA antigens (HLA system)**

**Human Leucocyte Antigens.** Antigens of major histocompatibility complex (MHC) in humans. HLA genes are located on the 6<sup>th</sup> chromosome in a region 6p21.31. HLA genes are divided into three distinct groups: class I, class II, and class III. The HLA system has a key role in the immune system, in the defense against a wide range of antigens., in tissue typing to identification of an individual's HLA antigens before transplantation. A number of HLA genes are associated with human disease, including autoimmune disorders.

### **Homeostasis**

Homeostasis is a term describing the status of physiological normality. Homeostasis is a self-regulating process by which biological systems tend to maintain stability while adjusting to conditions that are optimal for survival.

### **Homologous**

Generally, the word “homologous” is used to show a degree of similarity. It may be in position, structure, function, or characteristics. E.g. homologous antibodies are produced by humans (heterologous antibodies are produced by animals), are obtained from healthy donors, and are used for passive immunization. At present, the use of homologous sera predominates for the artificial induction of passive immunity.

### **HvG (host versus graft)**

Response of the host immune system against transplanted organ or tissue antigens. Transplanted cells, tissues, and organs are susceptible to destruction by the host immune system.

### **Hyperreactivity**

Called also hyperresponsiveness, is an abnormally high sensitivity to stimuli. For example, in allergy, there is hyperreactivity of the immune system.

### **Hypersensitivity**

Hypersensitivity is an increased reactivity or sensitivity to an antigen to which it has been previously exposed. This term is often used as the synonym for an allergy. Hypersensitivity is divided into categories according Coombs and Gell classification. There are types I, II, III, and type IV. reaction.

### **Hypogammaglobulinaemia**

Hypogammaglobulinemia is a problem with the immune system that prevents it from making enough antibodies called immunoglobulins. Total plasma immunoglobulin concentration is decreased compared to values in the general population.

### **Hyporeactivity**

Hyporeactivity is abnormally low sensitivity to stimuli, e.g. hyporeactivity in the elderly, when even severe diseases sometimes occur without high fevers.



### **ICAM (Intercellular adhesion molecules)**

Intercellular adhesion molecules are cell-surface ligands for the leukocyte integrins and are important in the binding of lymphocytes and other leukocytes to a certain cell, antigen-presenting cells and endothelial cells. They are members of the immunoglobulin superfamily (ICAM-1, ICAM-2....). ICAM-1 is rapidly inducible on the endothelial cells by inflammation and plays an important role in local inflammatory reactions. These molecules even appear on cells that did not have it before (epithelial cells, fibroblasts), and thus helps to localize leukocytes to the site of inflammation.

### **Idiotope**

Idiotope is an idiotype epitope. The binding site (epitope) in the hypervariable regions of antibodies or specific T-cell receptors differs in the structure that recognizes the antigen.

### **Idiotype**

An idiotype is made up of a series of idiotopes or idiotype epitopes.

### **IgA**

Immunoglobulin A is the class of immunoglobulin characterized by  $\alpha$  heavy chain. This is an antibody that plays a crucial role in the immune function of mucous membranes.

### **IgD**

Immunoglobulin D is the class of immunoglobulin characterized by  $\delta$  heavy chain. It is surface immunoglobulin on mature B cells.

### **IgE**

Immunoglobulin E is the class of immunoglobulin characterized by  $\epsilon$  heavy chain. It is important in allergic reactions and helminthic parasitic infections.

### **IgG**

Immunoglobulin G is the class of immunoglobulin characterized by  $\gamma$  heavy chain. It is important in the secondary immune response. IgG is the major serum immunoglobulin. Its major roles are opsonization, activation of complement. It can neutralize antigens and cross the placenta.

### **IgM**

Immunoglobulin M is the class of immunoglobulin characterized by  $\mu$  heavy chain. It is important in the primary immune response. It is the first immunoglobulin to be secreted during the acute stage of infection. It is the first surface immunoglobulin on B cells.

### **Immune complex**

Also known as the antigen-antibody complex. Antigen and antibody are bound, forming immune complexes (that can activate the classical pathway of complement). These interactions are noncovalent specific biochemical reactions. Immune complexes can vary



from small soluble complexes to large insoluble complexes that precipitate out of solution. Antigen-antibody complexes circulate in the blood and may lead to inflammation at the site of deposition, often resulting in vasculitis (blood vessel inflammation), glomerulonephritis, arthritis, generally called immune-complex-mediated disease.

### **Immune response**

An immune response is a reaction which occurs within an organism for the purpose of defending against foreign invaders which could cause serious problems to the health of the host organism. Two distinct types of immune response are the innate and the adaptive response, which works together to protect against pathogens.

### **Immune system**

The immune system is a host defence system, which comprises many biological structures and processes within an organism that protects against disease. A system that protects an organism against foreign infectious material enables removal of its own damaged or dead tissues and cells, including tumours.

### **Immunity**

Immunity is the ability of an organism to distinguish between "self" and "non-self" molecules and to respond against a foreign invader with a characteristic immune response, which results in the elimination of the invader. It is secured by the immune system. The immune system is primarily involved in defence against infectious organisms, but it also plays a role in various other diseases. Self molecules are those components of the organism that can be distinguished from foreign substances by the immune system. Non-self molecules are those recognized as foreign molecules. Immunity involves both specific and nonspecific components. "Foreign" are antigens that are not present in one's own organism. These are most often microbial or parasitic antigens, in some cases self-antigens can also be recognized as foreign antigens. Transplanted organs and tissues are also examples of foreign antigens.

### **Immunity non-specific, innate**

The innate immunity provides an immediate non-specific immune response if a pathogen crosses physical, biological and chemical barriers. Innate immunity forms the first immunological line of defence and enables very fast reaction of the organism to the presence of the pathogen. It is phylogenetically older than specific immunity. Responses of innate immunity are non-specific. Exposure to the pathogen leads to immediate maximal response. It contains cell-mediated and humoral components. Immunological memory is not present. During the first and repeated contact with the same antigen, it has the same course, the speed and intensity of the response do not change. Cellular components of innate immunity are polymorphonuclear leukocytes (neutrophils, eosinophils, basophils), macrophages, dendritic cells, mast cells, NK cells. Soluble components are cytokines, complement, defensins, lysozyme, proteins of the acute phase. Innate immunity use pattern recognition receptors (PRRs) to recognize molecular structures that are produced by microbial pathogens called pathogen-associated molecular patterns (PAMP) or damage-associated molecular patterns (DAMPs), which are associated with components of host's cells that are released during cell damage or death.



### **Immunity specific, adaptive**

The adaptive immunity is the second line of immunological barriers if pathogens successfully evade the innate response. In adaptive immunity, the immune system adapts its responses during an infection to improve its recognition of the pathogen. This improved response is then retained after the pathogen has been eliminated, in the form of immunological memory, and allows the adaptive immune system to mount faster and stronger attacks each time this pathogen is encountered. If a pathogen infects the body more than once, specific memory cells are used to quickly eliminate it. The adaptive immune response is antigen-specific and requires the recognition of specific "non-self" antigens during a process called antigen presentation. Adaptive immunity contains cell-mediated and humoral components. Cellular components of adaptive immunity are T cells and B cells. T cells are involved in cell-mediated immune response, whereas B cells are involved in the humoral immune response. Humoral components of adaptive immunity are antibodies produced by plasma cells, which recognize specific antigens and mark them for destruction or neutralize them.

### **Immunocompromised**

An individual at risk of decreased immunity, immunosuppression.

### **Immunological ignorance**

Immunological ignorance is a condition in which the immune system does not respond to a specific antigenic stimulus. During an individual's development, immunological tolerance naturally develops against its own antigens. Tolerance to self-antigens develops in T-lymphocytes as they mature in the thymus and in B-lymphocytes in the bone marrow. During this process, those lymphocytes that could potentially respond to the body's own antigens are killed by apoptosis. It is a form of self-tolerance in which reactive lymphocytes and their target antigen are both detectable within an individual.

### **Immunological memory**

Immunological memory is an essential feature of adaptive immunity. An organism that comes into repeated contact with the same antigen will develop an immune response much faster and more effective than the first contact with that antigen, thanks to immunological memory. It is provided by memory T and B cells.

### **Immunological synapse**

Immunological synapse is a highly organized contact between T cell and the antigen-presenting cell. It allows antigen recognition and is involved in T cell activation. At the centre of the synapse is a TCR receptor recognizing an antigen bound to MHC molecules. The formation of a synapse is associated with the reorganization of the lymphocyte cytoskeleton.

### **Immunogen**

An immunogen is a specific type of antigen that is able to elicit an immune response. It is a complete antigen. Immunogen produces a humoral or cell-mediated immune response, whereas antigens are any substance that binds specifically to an antibody or a T-cell receptor. All immunogens are antigens, but all antigens may not be immunogens, some very small molecules called haptens can bind to antibodies or B cell receptor, but they cannot initiate an immune response.



## Immunoglobulins

Immunoglobulins are all antibody molecules produced by plasma cells. Membrane-bound immunoglobulin works as the specific antigen receptor on B cells. The basic structure of an immunoglobulin consists of two identical heavy (H) chains and two identical light (L) chains that held together by a disulfide bond. The immunoglobulin is Y-shaped. In the variable portions, there are two antigen-binding sites (called Fab fragment) formed by both chains (heavy and light). In the constant portions of immunoglobulin isotype, there is one binding site (called Fc fragment) formed only by the heavy chains through which the immunoglobulin binds to some cells. In humans, there are two types of the light chain ( $\kappa$  and  $\lambda$ ) and five types of the heavy chain ( $\mu$ ,  $\gamma$ ,  $\alpha$ ,  $\epsilon$ ,  $\delta$ ) and on the basis of these five types of heavy chain there are five classes of immunoglobulins called IgM, IgG, IgA, IgE, IgD.

## Immunoglobulin superfamily

A group of protein molecules that have a similar structure and organization to immunoglobulins. They probably have a common evolutionary origin. They are involved in antigen recognition and interactions between cells in the immune system and other biological systems. In addition to immunoglobulins, this also includes TCRs (T-cell receptors), molecules found on T-lymphocytes (CD4, CD8, CD7, etc.), NK cells (CD56, KIR, KAR, etc.), nervous system cells (MAG, Po), HLA antigens, some adhesive molecules (ICAM, VCAM, LFA, etc.).

## Immunology

The branch of medicine that is concerned with the structure and function of the immune system, innate and acquired immunity, laboratory techniques involving the interaction of antigen and antibodies.

## Immunostimulants

Immunostimulants, also known as immunostimulators, are substances (drugs and nutrients) that stimulate the immune system by inducing activation or increasing activity of any of its components. Many immunostimulators activate innate immunity and promote the release of endogenous immune mediators (e.g., cytokines). They can amplify different effectors of the immune responses, including phagocytosis, the intracellular killing of organisms, antigen presentation, cytotoxic activity, antiviral activity, cytokine release, or antibody production.

## Immunosuppressive agents

Immunosuppressive drugs, also known as immunosuppressive agents, are drugs that inhibit or prevent the activity of the immune system. Immunosuppressive drugs nonspecifically diminish immune responses, and these agents are essential for preventing organ rejection after transplantation. These drugs are also used to treat autoimmune disease, allergic disorders, and several other diseases.

## Immunosuppressive therapy

Treatment which suppress adverse immune reactions, especially in autoimmune diseases, and after transplantation. It includes corticoids, azathioprine, cyclosporine, cyclophosphamide and others.



### **Immunotoxicity**

Immunotoxicity is defined as adverse effects on the functioning of both local and systemic immune systems that result from exposure to toxic substances. Alteration in the immune system may result in either immunosuppression or exaggerated immune reaction. Immunosuppression may lead to the increased incidence or severity of infectious diseases or cancer, since the immune system's ability to respond adequately to invaders is suppressed.

### **Incompatibility**

Differences in HLA antigens between donor and recipient.

### **Inflammatory response**

The inflammatory response is a general term that describes the battle that macrophages, neutrophils, and other immune system cells wage against an invader.

### **Interferons**

Interferons are a group of signalling proteins made and released by host cells in response to the presence of several pathogens, such as viruses, bacteria, parasites, and tumour cells. Interferons belong to the large class of proteins known as cytokines. These molecules are used for communication between cells to trigger the protective defences of the immune system that help eradicate pathogens.

### **Interleukins (cytokines)**

Interleukins are proteins (cytokines) that are used for communication between leukocytes. They can be produced by various cells after their activation: lymphocytes, monocytes, macrophages, endothelial cells, fibroblasts, mast cells etc. They affect cells that have receptors for their molecules. They interact with each other, and affect the cells of the immune system, as well as the cells of other systems. Their action is complex, they have, in addition to the main ones, also side and regulatory effects.

### **Isotype of immunoglobulins**

A synonym for class of immunoglobulins. The isotype of an antibody (e.g., IgM, IgG, IgA, IgE, IgD) is determined by the constant region of its heavy chain.

### **Isotype switching**

Isotype switching or class switching undergo activated B cells. The first antibodies produced in the humoral immune response are immunoglobulins IgM. During the synthesis of immunoglobulins, other classes of immunoglobulins, namely IgG, IgA or IgE, begin to be produced. Isotype switching is abundant with interleukins (e.g., interleukin II-4 causes switching toward IgE). Isotype switching does not affect antibody specificity significantly but alters the effector functions that the antibody can engage.



### **Jarisch-Herxheimer reaction**

Jarisch-Herxheimer phenomenon is a reaction due to bacterial endotoxins and microbial antigens that are liberated by the destruction of microorganisms. The reaction is characterized by fever, tender lymphadenopathy, arthralgias, transient macular or urticarial eruptions, and exacerbation of preexisting cutaneous lesions. This is an aggravation of the symptoms of infectious disease after starting treatment (e.g. with antibiotics) due to the massive breakdown of bacteria and the release of large amounts of toxic substances that trigger an immune response.

### **J-chain**

J-chain is the joining chain. It is a small polypeptide, which regulates polymer formation of immunoglobulin IgA and IgM. J-chain incorporation into polymeric IgA (mainly dimers) and pentameric IgM endows these antibodies with several salient features.

### **Jenner vaccination**

The history of vaccines begins with the story of smallpox. Vaccination with smallpox was performed by Edward Jenner in 1796 to prevent smallpox. His attempt is considered the first real vaccination.

### **Jo-1 antibodies**

Jo-1 antibodies belong to the anti-ENA antibodies. ENA is an extractable nuclear antigen. Jo-1 antibodies are a marker for the disease polymyositis and occur most commonly in myositis patients who also have interstitial lung disease. They are found in about 60% of patients with a combination of myositis and fibrosing alveolitis. Jo-1 is considered as a useful prognostic marker for more severe clinical course, frequent active episodes and a poor prognosis.

### **Juvenile idiopathic arthritis (JIA)**

Juvenile idiopathic arthritis (JIA) is the most common type of arthritis in kids and teens. It typically causes joint pain and inflammation in the hands, knees, ankles, elbows or wrists. But, it may affect other body parts too. JIA used to be called juvenile rheumatoid arthritis (JRA), but the name changed because it is not a kid version of the adult disease. JIA is an autoimmune or autoinflammatory disease. That means the immune system, which is supposed to fight invaders like germs and viruses, gets confused and attacks the body's cells and tissues. This causes the body to release inflammatory chemicals that attack the synovium, tissue lining around a joint. Synovium produces fluid that cushions joints and helps them move smoothly. Inflamed synovium may make a joint feel painful or tender, look red or swollen or difficult to move.

# K

## **Kappa chain – $\kappa$ chain**

Kappa is one of two classes of light chain. Light chain is the smaller of the two types of polypeptide chain that make up all immunoglobulins. The next class light chain is called lambda.

## **KAR (killer activation receptors)**

Killer Activation Receptors (KARs) are receptors expressed on the plasmatic membrane of NK cells. KARs can detect a specific type of molecules: MICA and MICB. These molecules, MICA and MICB, appear in infected or transformed tumour cells, but they are not very common in healthy cells. KARs recognise MICA and MICB when they are in a huge proportion and get engaged. This engagement activates NK cell to attack the transformed or infected cells. This is an important process within innate immunity.

## **K cells (Killer cells)**

K cells (killer cells) are a heterogeneous group of cells (monocytes, macrophages, neutrophils and eosinophils, NK cells). They are rather a functional type of leukocytes that are capable of destroying a cell in conjunction with an antibody bound to it. K cells participate in ADCC response - antibody-dependent cellular cytotoxicity. K cells are components of innate immunity. They have FcR (Fc receptor) on their surface and are therefore able to bind Fc part of the antibody. If this antibody has bound to the antigen on a cell surface, effector ADCC cell can bind to the Fc part of this antibody and kill the antigen-bearing cell.

## **KIR (killer inhibition receptors)**

Killer Inhibition Receptors (KIRs) recognize certain molecules in the MHC class I of the host cell and get bind with them. These molecules are typical of healthy cells and are repressed in virus-infected or transformed tumour cells. Killer Inhibitory Receptors (KIRs) examine the surface of the virus-infected and tumour cells in order to determine the levels of MHC class I molecules they have. If KIRs identify sufficient number MHC class I molecules, the “killing signal” is overridden to prevent the killing of the cell. In contrast to this, if KIRs identify not sufficient number MHC class I molecules, killing of the target cell proceeds.

## **Kupffer cells**

Kupffer cells are liver macrophages, which play a crucial role in maintaining liver functions. Under physiological conditions, they are the innate immune cells and protect the liver from bacterial infections.



# L

## **LAK cells (Lymphokine Activated Killers cells)**

LAK cells have non-specific cytotoxic activity. They are lymphokine-stimulated killer cells (activated NK cells). These cells have enhanced cytotoxic activity so that they also kill cells that normally NK cells cannot destroy.

## **Lambda chain – $\lambda$ chain**

Lambda is one of two classes of light chain. Light chain is the smaller of the two types of polypeptide chain that make up all immunoglobulins. The next class light chain is called kappa.

## **Langerhans' cells**

Langerhans' cells are phagocytic dendritic cells. They belong to antigen-presenting cells found in the epidermis.

## **Latex agglutination**

The latex agglutination test is a serological laboratory method to detect certain antibodies or antigens in a variety of body fluids, including cerebrospinal fluid, urine, or blood. Latex agglutination test uses latex beads coated with a specific antibody or antigen. If the suspected substance is present, the latex beads will agglutinate together, and form clumps. The results are available after 15 minutes to an hour.

## **L chain**

Light chain (L chain) is the smaller polypeptide chain of the two types of chains present in the immunoglobulin monomer. It consists of one V (variable) and one C (constant) domain. Light chain is bound to the heavy chain with disulfide bond. There are two classes of light chain, called kappa  $\kappa$  or lambda  $\lambda$ . In one immunoglobulin molecule can be present only one type of light chain (only  $\kappa$  or only  $\lambda$ ).

## **Leukocyte**

Leukocyte is a white blood cell, generally. They are cells of the immune system that are involved in the protection of the body against both infectious disease and foreign invaders. Leukocytes include polymorphonuclear leukocytes, lymphocytes and monocytes. They all are produced and derived from multipotent hematopoietic stem cells in the bone marrow. Leukocytes are found throughout the body, including the blood and lymphatic system.

## **Leukotrienes**

Leukotrienes are lipid mediators of inflammation and allergic reactions. They are derived from the arachidonic acid, the precursor of prostaglandins. They have a chemotactic effect, increase vascular permeability, contribute to oedema, have a bronchoconstrictive effect, promote smooth muscle proliferation (hypertrophy in bronchial asthma), increase bronchial mucus production and have many other effects. The most important are LTC<sub>4</sub>, LTD<sub>4</sub> and LTE<sub>4</sub>.



## Ligand

It is a substance or part of a substance that is capable of binding to a specific receptor.

## Lymph

Lymph is the extracellular fluid that is accumulated in tissues and is carried by lymphatic vessels back through the lymphatic system to the thoracic duct and into the blood.

## Lymphatic system

The lymphatic system is the network of vessels and other tissues, including the lymph nodes, Peyer's patches, tonsils, spleen, thymus, bone marrow and other organized lymphoid elements, which communicate directly with the blood. This system transports lymph throughout the body.

## Lymphatic vessels

Lymphatic vessels are thin-walled vessels that conduct lymph between different parts of the body. They include tiny lymph capillaries, which are microvessels located in the spaces between cells, and they serve to drain and process the extracellular fluid. The larger vessels, including the right lymphatic duct and the left lymphatic duct (called thoracic duct), serve to forward the lymph into the larger collecting ducts, and to return it to the bloodstream via one of the subclavian veins.

## Lymph nodes

The lymph nodes are a type of lymphoid organs. This organized collection of lymphoid tissue is found in many locations throughout the body along the lymphatic system. They are sites where acquired immune responses are initiated.

## Lymphoblast

Lymphoblast is a morphologically immature white blood cell characterized by more abundant cytoplasm than in a lymphocyte. Lymphoblasts that grow and divide uncontrollably cause a type of cancer known as acute lymphoblastic leukemia.

## Lymphocytes

Lymphocytes are a class of white blood cells with variable surface receptors for antigen. There are two main classes of lymphocytes. B lymphocytes (B cells), which mediate adaptive humoral immunity, and T lymphocytes (T cells), which mediate adaptive cell-mediated immunity. They originate from a lymphoid line from a pluripotent hematopoietic stem cell. They survive in the body for a long time. They can be activated to effector cells or can form memory cells. They interact with other cells of the immune system.

## Lymphocytosis

Lymphocytosis is an increased number of lymphocytes in the blood. It occurs in some viral infections (infectious mononucleosis caused by Epstein-Barr Virus or Cytomegalovirus, HIV infection caused by Human Immunodeficiency Virus, influenza, hepatitis, mumps, measles, rubella, adenovirus infection, etc.), bacterial infections (cat scratch disease caused by *Bartonella henselae*, pertussis caused by *Bordetella pertussis*, brucellosis, syphilis, mycobacterial tuberculosis), parasitic infections (toxoplasmosis, malaria, babesiosis), some lymphoproliferative disorders (Chronic Lymphocytic Leukemia, Non-Hodgkin Lymphoma, etc.), asplenia.

## Lymphoid organs

Lymphoid organs are sites where adaptive immune responses are initiated and where lymphocytes are maintained. Lymphoid organs can be classified into two main groups: primary and secondary. Primary lymphoid organs (also called central lymphoid organs) are sites where lymphocytes are generated. These include bone marrow and thymus. Both T and B cells originate in the bone marrow. Only B cells mature there. T cells mature in the thymus. Secondary lymphoid organs (also called peripheral lymphoid organs) are sites, where mature lymphocytes interact with antigen, and the adaptive immune responses are initiated. They include the lymph nodes, spleen, tonsils, and mucosal-associated lymphoid tissues in which immune responses are induced.

## Lymphokines

Lymphokines are cytokines produced mainly by T lymphocytes, which are involved in regulating immune responses. Lymphokines can facilitate cell proliferation, differentiation and growth of cells.

## Lymphopenia

Lymphopenia is a decrease below normal in the number of lymphocytes in the peripheral blood. It can occur, e.g. in some congenital immunodeficiencies, radiation sickness. Severe lymphopenia is associated with reduced resistance to infections.

## Lymphotoxin

Lymphotoxin is produced by some CD4<sup>+</sup> T cells. Lymphotoxin is also called tumour necrosis factor  $\beta$  (TNF-  $\beta$ ) that is directly cytotoxic for some cells. Lymphotoxin has cytolytic and cytostatic properties for tumour cells that are sensitive to this lymphotoxin.

## Lymphotropic

Having an affinity for lymphatic tissue, lymphocytes (e.g. lymphotropic viruses infect lymphocytes).

## Lipoxygenase

An enzyme that catalyzes the conversion of arachidonic acid to leukotrienes.

## Lysis

Lysis is a disruption of cells due to interruption of the cell membrane integrity.

## Lysosome

A lysosome is a specialized cytoplasmic organelle enclosed by a membrane, which contains multiple hydrolytic enzymes. These enzymes are crucial for intracellular digestion of ingested particles. They occur in many cells but mainly in neutrophils and macrophages. Lysosomes fuse with phagosome to phagolysosomes.

## Lysozyme (muramidase)

Lysozyme (also called muramidase) is low molecular weight enzyme found in saliva, tears, nasal secretions, body fluids, lysosomal granules, serum, egg white, etc. Lysozyme hydrolyses  $\beta$ -1,4 glycosidic bonds between N-acetylmuramic acid and N-acetylglucosamine in the bacterial cell wall and thus causes lysis of bacterial cells. Lysozyme is effective, especially against gram-positive cocci.



### **Lytic granules**

Lytic granules are intracellular storage granules of cytotoxic T cells and NK cells. They contain perforins and granzymes and are characteristic of cytotoxic effector cells.

# M

## MAC

**Membrane-Attack Complex** of the complement system. Membrane attack complex arises as a result of complement activation. It creates pores (holes) in the membrane of the target cell and causes its death.

## Macrophage

Macrophages are large mononuclear phagocytic cells found in many tissues. They are derived from monocytes and are important in innate immunity and early phases of host nonspecific defence. Macrophages are professional phagocytes and antigen-presenting cells. They act as effector cells in humoral and cell-mediated immunity. Cytokine interferon- $\gamma$  activates macrophages to increase their capacity to kill intracellular microbes. According to the tissue in which they are found, they have different names such as Kupffer cells of the liver, alveolar macrophages of the lung, osteoclasts in the bone, or microglia of the CNS.

## Major basic protein (MBP)

Major basic protein is a low molecular weight cationic protein present in eosinophilic granules and is released from granules when eosinophils are activated.

## Major Histocompatibility Complex (MHC)

**Major Histocompatibility Complex** is a cluster of genes on human chromosome 6 encoding histocompatibility antigens that are cell-surface glycoproteins. MHC genes encode class I, class II and the third category of class III molecules. MHC class I molecules present peptides to CD8 T cells. MHC class II molecules present peptides to CD4 T cells.

## MALT (Mucosa-Associated Lymphoid Tissue)

Mucosa-associated lymphoid tissue is lymphoid tissue associated with the mucosa at various anatomical sites. The main sites of mucosa-associated lymphoid tissue are the gut-associated lymphoid tissue (GALT), bronchial-associated lymphoid tissue (BALT), nasal-associated lymphoid tissue (NALT). MALTs provide localized or regional immune defence against foreign antigens after immediate contact with them.

## Mancini test

Mancini test is a single radial immunodiffusion test to determine the quantity of an antigen in a sample.

## Mannose-binding lectin (MBL)

Mannose-binding lectin is an acute phase inflammatory protein that increases during inflammation and is an important part of innate immunity. It is a plasma protein, also known as the mannose-binding protein that binds mannose, which is a typical surface component of bacterial cell walls of many microorganisms. It opsonizes pathogens bearing mannose on their surfaces and activates the complement system via MBL pathway.

### **Mannose-binding lectin pathway (MBL pathway)**

The mannose-binding lectin pathway is similar to the classical pathway of complement activation, but the activator is not the antibody but the serum mannose-binding lectin (MBL – mannose-binding lectin). MBL binds to the surface of the microorganism, the MASP-1 and MASP-2 proteinases bind to it, thereby forming a complex similar to C1qrs, and a cascade of activation may continue as in the classical pathway. In this case, the presence of antibodies is not required as in the classical pathway of activation.

### **Margination**

Margination is the adherence of leukocytes in the peripheral blood to the endothelium of vessels. Margination of leukocytes occurs during inflammation, and it is followed by their migration out of the vessels.

### **MASP-1 and MASP-2**

They are components of the MBL pathway of complement activation. They are serine proteases that bind to mannose binding-lectin and play a role in cleaving C4, thereby forming a complex similar to C1qrs and a cascade of activation may continue as in the classical pathway.

### **Mantoux test**

It is a tuberculin skin test in which intradermal injection of tuberculin is applied to test cell-mediated immunity. There is tested delayed type of hypersensitivity (type IV) to *Mycobacterium tuberculosis*. A positive test indicates previous or current infection with this pathogenic bacteria.

### **Mast cells**

Mast cells are mononuclear cells with metachromatically staining granules and have a relatively small core. They are found in connective tissue, especially in blood, lymphatic vessels and peripheral nerves. Mast cells are localized primarily near the epithelial surfaces of the respiratory, digestive system and skin exposed to allergens from the external environment. They are morphologically similar to basophils that circulate in the blood. Their granules contain many inflammatory mediators (heparin, histamine, etc.). These cells do not contain peroxidase. Mast cells are the most critical cells in allergic reactions. In their cell membrane, there are receptors for immunoglobulins IgE (FcεRI). The first contact with the allergen sensitizes the individual, generating specific IgE antibodies that bind their Fc fragments to mast cells. Following subsequent exposure of an individual to the same antigen, the antigen binds to the bound IgE antibodies, causing degranulation of mast cells and release of mediators of the allergic reaction into the extracellular space, which result in contraction of smooth muscle, bronchi, significant vasodilation and fluid penetration into the extravascular space.

### **Mastocytosis**

Mastocytosis is an overproduction of mast cells.

### **Maternal antibodies**

Maternal antibodies are immunoglobulins passed on to offspring in utero and in the neonatal period. Immunoglobulins IgG are transferred by way of the placenta. Only the IgG class of antibodies cross the placenta. Human colostrum and fresh breast milk contain specific and non-specific host resistance factors. Secretory IgA has the highest

concentration in colostrum. Human milk also contains IgG and IgM, as well as secretory IgA but in lower concentrations.

### **Maternal immunity**

Maternal immunity is a passive immunity transferred on the newborn from its mother via immunoglobulins IgG transported across the placenta from the maternal to the fetal circulation, and via immunoglobulins present in the colostrum and fresh breast milk during breastfeeding.

### **Mature B cells**

Mature B cells are B cells that express immunoglobulins IgM and IgD on their surface and are able to respond to antigen. These cells mature in the bone marrow and reside in peripheral lymphoid organs.

### **Mature T cells**

Mature T cells are classified on the basis of their surface CD markers such as CD4 and CD8. CD4+ T lymphocytes recognize antigens in the context of MHC class II molecules and participate in the immune response to exogenous antigens. CD8+ recognize antigens in the context of MHC class I molecules and participate in the immune response to endogenous antigens.

### **Membrane-attack complex**

The membrane-attack complex (MAC) is the result of complement cascade activation. MAC creates pores (holes) in the membrane of the target cell and causes lysis and death of the target cell.

### **Memory cells**

Memory cells are immunocompetent T and B lymphocytes that mediate immunological memory. They are more sensitive to the antigen than are naive lymphocytes and respond rapidly on reexposure to the antigen that originally induced them. Activated memory cells yield effector cells more rapidly than naive lymphocytes. Memory B cells and memory T cells persist in a functionally dormant state and are activated in secondary and subsequent immune responses to the antigen.

### **MICA and MICB**

These proteins are markers of stress and act as human stress ligands for killer activation receptors on NK cells. MICA and MICB are expressed by host cells that are unhealthy or abnormal for various reasons, including virus infection and tumours. Binding of MICA or MICB molecules by the killer activation receptors induces the NK cell to destroy the targeted host cell. This process is important in innate immunity.

### **Microglia**

Microglia is a population of cells that has the function of macrophages in the CNS.

### **Microphages**

Microphages are professional phagocytes, which include mainly neutrophils.

## Mitogen

Mitogen is a substance often derived from plants that non-specifically stimulates DNA synthesis and induces proliferation and cell division by mitosis. Lectins as representants of phytomitogens are widely used in immunology to evaluate T and B lymphocyte functions *in vitro*.

## Molecular mimicry

Molecular mimicry is one of the mechanisms by which an infectious agent can lead to the development of autoimmune processes. If a human is infected with a microorganism that has an antigen similar to or identical to the infected human's own antigen, the immune response originally induced against the microorganism's antigen may also target its self-antigens. This results in an autoimmune process that eventually damages the tissues or organs where a cross-reactive self-antigen occurs. Rheumatic fever is an example. Immunologic cross-reactivity between a bacterial antigen streptococcal M protein and human myocardial structures may lead to tissue injury.

## Monocytes

Mononuclear phagocytes are derived from promonocytes in the bone marrow. They are bigger than polymorphonuclear leukocytes. They migrate into the tissues and serous cavities and are precursors of macrophages.

## Monocyte-phagocytic system

Monocyte-phagocytic system is a system of cells that are important in nonspecific immunity. It includes monocytes, macrophages, some endothelial cells.

## Monoclonal

It is derived from a single clone.

## Monoclonal antibody

Antibodies that arise from a single B cell clone. They are completely identical and able to act against one particular antigen. They are used in the laboratory assays and have importance in health care. Monoclonal antibodies may direct immunotoxins or radioisotopes to tumour targets with potential for tumour therapy. They can kill target cells, suppress immune functions, and treat specific inflammatory diseases. Because they are derived from mouse cells, they can induce allergic reactions in humans.

## Monocyte

Monocytes are white blood cells derived from promonocytes in bone marrow. They are precursors of macrophages. After their migration into the tissues, they are transformed into macrophages. Monocytes are larger than polymorphonuclear leukocytes and have a kidney-shaped nucleus and the blue-greyish cytoplasm. They are active in phagocytosis.

## Monomer

Monomer is a subunit of an immunoglobulin molecule, which consists of two heavy and two light chains.

**Monokines**

They are cytokines produced by activated monocytes and macrophages. They have a regulatory effect on the other cells functions. Examples of monokines are IL-1 (interleukin-1) and TNF (tumour necrosis factor).

**Monovalent**

Monovalent is univalent. An example is monovalent antiserum, which is an antiserum against only a single antigen or epitope (also called monospecific antiserum).

**Mucosa-associated lymphoid tissue**

see MALT

**Multivalent**

Multivalent means possessing more than two binding sites. An example is multivalent antiserum is a serum containing antibodies specific for more than two antigens.

**Myeloperoxidase**

Myeloperoxidase is an enzyme present in granules of neutrophils. Myeloperoxidase has a bactericidal effect.

## N

**Naive cells**

Naive cells are lymphocytes that have not been exposed to antigen and have not yet been activated.

**Naive B lymphocytes**

Naive B lymphocytes are mature lymphocytes that have exited the bone marrow (central lymphoid organ) but has not yet come into contact with the antigen for which it is specific.

**Naive T lymphocytes**

Naive T lymphocytes have never encountered their specific antigen and thus have never responded to it. All T lymphocytes leaving the thymus (central lymphoid organ) are naive T lymphocytes.

**Natural killer cells (NK cells)**

NK cells are large granular non-T, non-B lymphocytes, which can attack and destroy certain virus-infected and tumour cells. NK cells are important in non-specific innate immunity to viruses, intracellular pathogens and ADCC (antibody-dependent cell-mediated cytotoxicity).

**Natural killer T cells (NKT cells)**

NKT cells are lymphoid cells with characteristics of both T cells and NK cells. After activation, NKT cells can secrete Th0 cytokines that facilitate activation and differentiation of both B and T cells. NKT cells may also induce cytolysis of target cells. It is similar to NK cells.

**NBT test**

Laboratory test for non-specific immunity. It detects respiratory burst in phagocytes by the reaction of nitroblue tetrazolium (NBT) with oxygen products. Nitroblue tetrazolium is converted from a yellow water-soluble compound to a dark-blue insoluble formazan that can be clearly detected microscopically.

**Necrosis**

Necrosis is the death of cells or tissues due to chemical or physical injury, in contrast to apoptosis, which is a biologically programmed cell death.

**Neoantigens**

Neoantigens are newly formed antigens, which have not been previously recognized by the immune system. They can arise from altered tumour proteins formed as a result of tumour mutations or from viral proteins.

**Neurokins**

Peptides produced in the nervous system that also affect the activity of the immune system, also called neuropeptides. They have an immunomodulatory effect and serve as

inflammatory mediators, e.g. CGRP (calcitonin gene-related peptide), VIP (vasoactive intestinal peptide), BDNF (brain-derived neurotrophic factor) and others.

### **Neutralization test**

Neutralization test is based on the ability of an antibody to inactivate the biological effects of an antigen.

### **Neutropenia**

Neutropenia is a lower level of neutrophils in the peripheral blood circulation than normal levels.

### **Neutrophils**

Neutrophils are white blood cells derived from the myeloid lineage that belong to polymorphonuclear leukocytes. They have multilobed nuclei and granules in cytoplasm. They can phagocytose but are not antigen-presenting cells. Neutrophils are important in non-specific innate immunity in the first line of cellular defence against invading microorganisms.

### **Neutrophilia**

Neutrophilia is a significantly increased level of neutrophils in the blood circulation.

### **NK cells (Natural Killer cells)**

NK cells are large granular, (non-T, non-B) lymphocytes, which kill certain tumour cells. They are important in innate immunity to viruses and other intracellular pathogens, as well as in ADCC reactions. NK cells also are involved in immune defences against tumours. Morphologically they are associated with large granular lymphocytes (LGL) with numerous granules in the cytoplasm that are rich on perforins and granzymes. NK cells do not express TCR, BCR. They can non-specifically recognize and kill certain foreign cells.

### **NKT cells**

see Natural Killer T cells

### **Non-specific immunity**

Non-specific immunity or innate (also natural) immunity is not dependent on immunologic memory. Mechanisms of non-specific immunity protect humans against microorganisms that cross the physical, chemical and biological barriers. It is the first immunological line of defence against infection or injury. Cells and molecules of innate immunity are present rapidly at the site of infection.



### **O-antigen**

The O-antigen, also called somatic antigen, is the lipopolysaccharide antigen located in the cell wall of a bacterium. It is a thermostable antigen. O-antigen is the most variable part of the lipopolysaccharide molecule. The differences of O-antigens are used in serological reactions (direct agglutination, serotyping).

### **Oncogenesis**

Oncogenesis is the process by which tumours develop.

### **Oncogenic viruses**

Oncogenic viruses are able to induce malignant transformation of cells. For example, DNA virus with oncogenic potential is human papillomavirus (HPV), oncogenic RNA viruses are retroviruses.

### **Opportunistic pathogen**

An opportunistic pathogen is a microorganism that can lead to the disease only in immunocompromised person. The infection caused by opportunistic pathogen is called opportunistic infection. Typical microorganisms that can cause opportunistic infection include *Candida albicans*, *Toxoplasma*, *Pneumocystis carinii*, cytomegalovirus and herpes virus.

### **Opsonin**

Opsonin is a substance that binds to the surface of bacteria or other particles to increase their susceptibility to phagocytosis. Opsonins are involved in opsonization. The most potent opsonins include antibodies (isotypes IgG), some components of complement, mannose-binding protein, CRP.

### **Opsonization**

Opsonization is a process that increases the efficiency of phagocytosis of foreign particles through the coating of their surfaces with opsonins.

### **Organ-specific antigen**

An organ-specific antigen is an antigen unique to a specific organ.

### **Ouchterlony test**

Ouchterlony test is the immunodiffusion method. Principally it is a double radial immunodiffusion. Both antigen and antibody are placed in separate wells in the agar plate. Antigen and antibody diffuse from the wells through the medium and a line of precipitation is formed at the zone of equivalence.



### **Oxygen-dependent killing**

Oxygen-dependent killing is activated by oxidative (respiratory) burst that results in the formation of hydrogen peroxide and other antimicrobial substances, which kill the microbes.

### **Oxygen-independent killing**

Oxygen-independent killing uses preformed cytoplasmic granules, which contain antimicrobial agents such as lysozyme, lactoferrin, antimicrobial cationic proteins and other cytotoxic molecules that have different microbial targets.

## P

**PAMP (pathogen-associated molecular patterns)**

Pathogen-associated molecular patterns are molecules such as lipopolysaccharides, peptidoglycan, lipoteichoic acid and mannans that are expressed only by microbes. They are never present on host cells. Receptors of the innate immunity called pattern-recognition receptors (PRR) recognize pathogen-associated molecular patterns (PAMP) of pathogens, and it results in inflammation with the aim of destroying the pathogen.

**p-ANCA**

p-ANCA are **p**erinuclear **A**nti-**N**eutrophilic **C**ytoplasmic **A**ntibodies, a group of autoantibodies directed against cytoplasmic components of the neutrophilic granulocytes. There are cytoplasmic (c-ANCA) and perinuclear (p-ANCA) according to the indirect immunofluorescence pattern. They are useful serological markers for vasculitides (e.g. microscopic polyangiitis, Churg-Strauss syndrome, polyarteritis nodosa) and glomerulonephritides. p-ANCA is targeted against myeloperoxidase.

**Pandemic**

Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

**Passive hemagglutination**

Passive hemagglutination is a method for the detection of antibody. In this method, red blood cells are carriers for an antigen. They are coated with an antigen and then the antibody is detected by agglutination of the coated red blood cells.

**Pattern recognition receptors**

see PRR

**PCR**

Polymerase chain reaction is one of the most widely used techniques in molecular biology and is used to make many copies of a particular region of DNA. The key components of a PCR reaction are primers, template DNA, *Taq* polymerase and nucleotides. The basic steps are denaturation, annealing and extension. Denaturation (96°C) provides single-stranded template for the next step. Annealing (55-65°C) – primers can bind to their complementary sequences on the single-stranded template DNA. The extension (72°C) – *Taq* polymerase extends the primers, and new strands of DNA are synthesized.

**Peyer's patches**

Peyer's patches are aggregates of lymphocytes along the small intestine, particularly the ileum. They are sites where immune answers to ingested antigens can be induced.

## Phagocytes

Two types of phagocytes are classified as professional phagocytes: polymorphonuclear leukocytes (mainly neutrophils and eosinophils, also called microphages) and macrophages. The function of phagocytes is on the one hand effector function – phagocytosis and elimination of microorganisms in the presence of bactericidal substances and hydrolytic enzymes and the regulatory function – mediated by the production of cytokines, prostaglandins, leukotrienes, etc. Microphages are mainly neutrophils and eosinophils. They circulate in the blood and are ready to move promptly to the site of inflammation. The advantage of these granulocytes is that they are ready to perform their effector functions immediately.

## Phagocytosis

Phagocytosis is the ability of professional phagocytes to recognize, absorb, kill and degrade foreign material. In non-specific defence, the most important barrier to the spread of microorganisms is their destruction by phagocytes. Phagocytosis is an active process, in which specialized cells of the immune system engulf, kill and break down microorganisms (or foreign material). It has a key role in innate non-specific immunity because phagocytes can recognize, ingest and destroy many pathogens without the aid of adaptive specific immunity.

## Phenotype

Phenotype is defined as the observable characteristics or traits of an organism that are produced by the interaction of the genotype and the environment. It is the physical expression of one or more genes.

## Photoallergen

Photoallergen is an agent, which elicits an allergic response to the light. The group of photoreactive allergens consist of allergens known to react with UV light. They are known to cause contact allergy cases.

## Photoallergy

Photoallergy occurs when certain photoreactive allergens in the skin absorb light and create an inflammatory response. These chemicals may be applied topically or diffuse into skin following systemic administration of a drug.

## Photoallergic contact reactions

Photoallergic contact reactions are less common than phototoxic reactions. They fall within the class of type IV cell-mediated hypersensitivity processes, in which a photoactivated chemical or a photoproduct is considered to act as either a hapten or a complete antigen. Ultraviolet exposure is required for both induction and elicitation of the immune response. Prior sensitization to the drug or chemical is required for photoallergic contact dermatitis to occur and thus this will not occur on first exposure to the agent and will only occur in individuals who have previously been sensitized.

## Photocontact reactions

Topical photocontact reactions are subdivided into phototoxic and photoallergic responses.

## Photodermatoses

Photodermatoses are caused by an abnormal reaction to sunlight, usually to its ultraviolet component. Photodermatoses are not life-threatening but can cause considerable suffering.

## Phototoxic contact reactions

Phototoxic reactions are much more common, nonimmunological, and thus theoretically will occur in anyone exposed to sufficient amounts of the phototoxic chemical in contact with skin and light of the appropriate wavelength.

## Phytohemagglutinin (PHA)

Phytohemagglutinin is a lectin or plant protein found mostly in red kidney beans (*Phaseolus vulgaris*) and has cell-agglutinating and mitogenic properties. It is mainly used to test cellular immunity in medicine. High amounts of this lectin are very toxic.

## Plasma

Plasma is a transparent yellow fluid component of blood containing water, plasma proteins and electrolytes. In plasma are also present fibrinogen and clotting factors. Plasma from which fibrinogen and clotting factors have been removed is called serum.

## Plasma cells

Plasma cells are terminally differentiated B cells. They are effector cells that secrete antibodies.

## Plasmacyte

see plasma cell

## Pollinosis

Pollinosis or hayfever is a human allergic reaction caused by many environmental substances. Common carriers include pollen, molds, house dust, ticks, mites, insects, reptile venoms, drugs and certain foods. Clinically is described as allergic rhinitis or conjunctivitis with typical symptoms such as intense sneezing, watery eyes, nasal obstruction, itchy nose and eyes and coughing. This is an IgE-mediated reaction, immediate (type I) hypersensitivity.

## Polyclonal antibodies

Polyclonal antibodies are antibodies that result from the activation of different B cell lineages within the body, whereas monoclonal antibodies come from a single cell lineage. Polyclonal antibodies react against a specific antigen, each identifying a different epitope.

## Polymorphonuclear leukocyte (PMN)

Polymorphonuclear leukocytes are white blood cells with multilobed nuclei and granules in cytoplasm. There are three types of PMN: the neutrophils with granules stained with neutral dyes, the eosinophils with granules stained with eosin, and the basophils with granules stained with basic dyes.

## Polyvalent

Multivalent. It means possessing more than two binding sites. An example is polyvalent/multivalent antiserum is a serum containing antibodies specific for more than two antigens.

## Postvaccination

Occurring after vaccination, e.g. post-vaccination complications

## Precipitation

Precipitation is a serological reaction of soluble antigen (called precipitinogen) and antibody (called precipitin) in liquid or agar media, which results in formation of the precipitate.

## Precipitin

Precipitin is an antibody that interacts with a soluble antigen to form a precipitate.

## Prick test

Skin prick testing is an allergy test used to identify allergens responsible for triggering symptoms in allergic diseases.

## Procalcitonin (PCT)

Procalcitonin is an acute-phase protein. During severe systemic inflammation, especially bacterial infection, there is an increased secretion of procalcitonin in many tissues, especially in the liver. Procalcitonin begins to rise approximately 2-4 hours after the onset of the inflammatory process and reaches a maximum in 12-24 hours.

## Programmed cell death

see apoptosis

## Protective immunity

Protective immunity is induced by active immunization with a vaccine.

## PRR (pattern-recognition receptors)

Pattern-recognition receptors recognize and bind to only non-self structures. They are normally present within the body but are not in the microbes. PRRs identify pathogen-associated molecular patterns (PAMP) typically associated with microbes. Some PRRs are found on the membranes of cells, others are in a soluble form.

## Pruritus

Pruritus or itch is defined as an unpleasant sensation that causes a desire to scratch. Itching may be present without concomitant skin changes (e.g. in the elderly due to skin aging or drying of the skin), or itching accompanied by a skin disease including eczema, or mycosis.

## Pseudoallergy

Allergy-like manifestations that are not caused by immunological mechanisms. They are caused by substances that contain histamine or substances that release histamine in a non-immunological way (e.g. foods that have a higher content of histamine or release it during chemical reactions in the digestive tract, or by the action of bacteria).

## Purified protein derivate (PPD)

PPD is a combination of soluble proteins that are used in the diagnosis of tuberculosis for a tuberculin skin test.



## **Pyrogen**

Pyrogen is a substance that induces fever.

# R

## **Radioimmunoassay (RIA)**

Radioimmunoassay is very sensitive and specific *in vitro* method to assay antigen or antibody labelled with radioactivity. The basic principle of RIA is competitive binding, where a radioactive antigen (called a tracer) competes with a non-radioactive antigen for a fixed number of antibody or receptor binding sites. This method is used usually to measure concentrations of antigen (e.g. hormones, enzymes levels in the blood) by use of antibodies.

## **Reagins**

It is an older designation of IgE immunoglobulins, which initiate the release of mediators of the allergic reaction from basophils and mast cells (e.g. histamine, heparin).

## **Reactive arthritis**

Reactive arthritis is a condition that causes inflammation, redness and swelling in various joints, especially the knees, feet, toes, hips and ankles. It usually occurs 1-4 weeks following an acute bacterial infection.

## **Receptor**

A receptor is defined as a protein that binds to an extracellular ligand, and then undergoes a conformational or biochemical shift and initiates a chain of intracellular signals by which the cell reacts to the extracellular signal.

## **Recombination of DNA**

Recombination involves the exchange of genetic material between multiple chromosomes or between different regions of the same chromosome. By this process, pieces of DNA are broken and recombined to produce new combinations of alleles.

## **Rejection**

Rejection is a post-transplant reaction that results in the rejection of the transplanted tissue or organ. Hyperacute rejection is due to preformed antibodies and occurs within minutes after transplantation. Acute rejection occurs within days to weeks following transplantation. Chronic rejection occurs more than 60 days after transplantation.

## **Relapse**

Relapse is the return of signs and symptoms of a disease after a remission.

## **Respiratory burst**

Respiratory burst is a process that neutrophils and macrophages use to kill certain microorganisms. It is connected with increased consumption of oxygen and leads to the production of hydrogen peroxide and the number of other mediators that are involved in killing of ingested microorganisms.

### **Revaccination**

Revaccination is a second or subsequent vaccination of people that were previously vaccinated. The administration of a vaccine again some period after the initial vaccination leads to strengthen or renew the immune response (e.g. tetanus).

### **Reverse transcriptase-polymerase chain reaction (RT-PCR)**

RT-PCR is a method to amplify RNA sequences and thus is important in molecular biology. The enzyme reverse transcriptase is used to convert RNA sequence into complementary DNA, and so to be cloned.

### **Rheumatic fever**

An inflammatory disease that results from a sterile consequence of *Streptococcus pyogenes* infection if the infection has not been adequately treated with antibiotics. Antibodies to streptococcal antigens cross-react with the body's own antigens. It mainly affects children and young people. It occurs two to three weeks after a streptococcal infection. It is manifested by fever, migrating joint pain with oedema, heart disease (myocarditis, endocarditis, pericarditis or pancarditis), neurological disease (chorea minor), skin erythema.

### **Rheumatoid arthritis**

Rheumatoid arthritis is an inflammatory disease of various joints due to an autoimmune response. A rheumatoid factor is present in the sera of patients with rheumatoid arthritis. When IgM rheumatoid factors and IgG molecules react to form immune complexes, complement is activated, and inflammation and immune injury is started.

### **Ribosome**

The ribosome is a subcellular organelle in the cytoplasm of cells where protein synthesis takes place.

## S

**Scavenger receptor**

Scavenger receptors are present mainly on macrophages. They can identify a variety of ligands including endogenous and modified host-derived molecules and pathogenic microbes. Scavenger receptors bind multiple ligands and promote the removal of non-self or altered self structures.

**Secondary antibody response**

The secondary antibody response is the antibody response induced by a second or subsequent contact with the same antigen than in the primary antibody. The secondary antibody response is more rapidly, last longer, and antibody levels are greater than those in the primary antibody response. IgG are predominantly antibodies produced in the secondary response.

**Secondary lymphoid organs**

Also termed peripheral lymphoid organs, are the lymph nodes, spleen, mucosal-associated lymphoid tissues. In secondary lymphoid organs, the immune answers are induced.

**Secondary granules**

Secondary granules are specific granules in the cytoplasm of polymorphonuclear leukocytes that contain lactoferrin and lysozyme.

**Secondary immunodeficiency**

Secondary immune deficiency occurs when the immune system is compromised due to external factors, not genetic factors. Examples include infections such as AIDS, immunosuppressive medication, severe burns, malnutrition, cancers, chronic diseases such as diabetes. In contrast, primary immunodeficiencies are caused by inherited/genetic defects of the immune system.

**Second signal**

The second signal (co-stimulatory signal) is the second of two signal, which is required to the lymphocyte activation. Both first and second signals are required for the activation of lymphocytes.

**Selectins**

Selectins are cell adhesion molecules that play a role in the adhesion of leukocytes to the endothelial cells.

**Selective IgA deficiency**

Selective IgA immunodeficiency is the most common primary immunodeficiency disorder characterized by absent levels or decreased levels of immunoglobulin IgA in the blood and secretions. People with IgA deficiency may appear healthy or may have a mild form of illness because they produce all the other classes of immunoglobulin. People with selective IgA deficiency are susceptible to many infections, especially in the respiratory and digestive tract.

## Sensitization

Sensitization is a prior immunization by the allergen that elicits the acute response. An allergic reaction occurs only in sensitized persons.

## Sepsis

Sepsis is a very serious bloodstream infection that often leads to death. Infection of the blood with gram-negative bacteria results in endotoxin septic shock through the release of cytokines such as TNF- $\alpha$ , IL-12.

## Septicemia

Septicemia is the presence of pathogens or their toxins in the bloodstream, which is accompanied by acute systemic illness. Septicemia is also called blood poisoning.

## Septic shock

Septic shock occurs in persons with sepsis, frequently caused by gram-negative bacteria. It results from the effects of released endotoxin (endotoxin shock). Septic shock is associated with life-threatening circulatory and metabolic abnormalities. It is manifested by dangerous low blood pressure (hypotension), increased capillary permeability, vasodilation and vascular collapse, disseminated intravascular coagulation (DIC) and multiple organ failure.

## Seroconversion

The phase of infection when specific antibodies against an etiological agent during the infection are first detectable in the serum.

## Serological reactions

Serological reactions are in vitro reactions of antigen with antibody in a particular environment. They are used in serological assays usually to detect the presence of antibodies in human serum against foreign antigens (e.g. microorganisms) or self-antigens (e.g. rheumatoid factor).

## Serotype

The serotype is important for the classification of microorganisms of the same species on the basis of their different antigenic structures. Different serotypes of the same species of microorganism will trigger the production of different antibodies in humans. Serotyping is important in the epidemiology of infectious diseases, including infections caused by *Salmonella*, *Shigella*, *Escherichia*, *Streptococcus*, and other bacteria.

## Serotyping

It is a direct diagnostic method in which an unknown antigen is identified using specific antisera. It is used to identify the serotype of bacteria using polyvalent and monovalent sera.

## Serum

The serum is the yellow fluid component of clotted blood. Serum does not contain fibrinogen and clotting factors. It is more common to use serum than plasma to the laboratory diagnosis in immunology such as detection of antibodies, because clotting may interfere with certain assays.

### **Serum sickness**

A disease that occurs after repeated parenteral administration of foreign proteins or drugs. It belongs to the type III hypersensitivity reaction with the formation of immunocomplexes that settle in the joints, vessels, etc. The symptoms appear 1-2 weeks after application. Immune-mediated tissue injury is manifested by fever, joint pain, skin symptoms, urticaria, possibly diarrhoea, or lymphadenopathy.

### **Severe combined immunodeficient disease (SCID)**

SCID is the example of an inherited defect in the combined lymphocyte lineage. Characteristics of SCID are failure of infants to gain weight normally, skin rashes, diarrhoea, high susceptibility to infection, numbers and functions of T and B lymphocytes are reduced or absent, level of immunoglobulins are reduced or absent.

### **SGR (somatically generated receptors)**

Somatically generated receptors are generated randomly before any contact with the antigen. They are present on T and B lymphocytes, each having a unique receptor capable of recognizing only a single structure, but the total number of cells allows a pool of receptors capable of recognizing more than  $10^{10}$  different structures. They are important in adaptive immunity.

### **Single radial immunodiffusion**

Single radial immunodiffusion is a method to detection of quantity of antibodies or antigens. If antibodies are detected, an antigen is incorporated into agar, and antibodies with known quantity and patients serum (in which are antibodies detected) are placed in the wells. Both the antigen and the antibody diffuse into the agar and produce a ring of precipitation in the zone of equivalence. The antibody concentration is determined from the diameter of the precipitation ring. This method is also known as Mancini.

### **Sjögren's syndrome**

Sjögren's syndrome is an autoimmune exocrinopathy characterized by both organ-specific autoimmunity and systemic manifestations. The diminution of gland secretions causes dry mouth and dry eyes.

### **Soluble**

Solubilized in aqueous solution, e.g. soluble antigen.

### **Somatic antigen**

Somatic antigen is the O antigen. It is a part of the cell wall of bacteria.

### **Spleen**

The spleen is the secondary lymphoid organ. It is the largest lymphoid organ, located in the upper the left side of the peritoneal cavity. It has a smooth glossy surface of dark red colour. It consists of white and red pulp.

### Streptolysin

Streptolysin is an exotoxin that is produced by some streptococci capable of inducing hemolysis. The best known are streptolysins type S and O. Antibodies against streptolysin O (antistreptolysin ASO) are standardly determined in the laboratory.

### Superantigens

Superantigens are antigens that do not require processing by antigen-presenting cells for their interaction with the immune system and are able to induce the activation of large numbers of lymphocytes. E.g. toxic shock toxin of *Staphylococcus aureus*, staphylococcal enterotoxins, pyrogenic exotoxins of *Streptococcus pyogenes*, superantigens of *Mycoplasma*.

### Syngeneic graft

A graft between two different individuals who are genetically identical (e.g. identical twins). It is accepted as self.

### Systemic lupus erythematosus (SLE)

Systemic lupus erythematosus is a connective tissue disease and belongs to systemic autoimmune diseases. Its clinical manifestations are so diverse and variable that the American College of Rheumatology has established a list of 11 criteria. SLE is defined if at least four criteria of them are present. Criteria are malar rash, discoid rash, photosensitivity, oral or nasopharyngeal ulceration, non-erosive arthritis involving two or more joints, serositis, nephritis, neurologic disorder, hematological disorder, immunological findings of the abnormal presence of autoantibodies and notably AntiNuclear Autoantibodies (ANA).

### Switch

It is the change of one isotype of heavy chain to another isotype during differentiation (e.g. from  $\mu$  chain to  $\gamma$  chain). Isotype switching does not alter the antigen-binding site of the chain.

## T

### Taq polymerase

Taq polymerase is a heat-resistant DNA polymerase used in PCR reactions. It originates from thermophilic bacterium *Thermus aquaticus*.

### T cells or T lymphocytes

They are lymphocytes that belong to the agranular white blood cells. They arise from a pluripotent hematopoietic stem cell in the bone marrow. They acquire their final morphological-functional form in a thymus. They are responsible for specific cell-mediated immunity. They represent a heterogeneous population, based on a different antigen-specific receptor (TCR) they are divided into TCR $\alpha\beta$  or TCR $\gamma\delta$ . In practice, T lymphocytes differ based on the presence of cell-surface molecules known as clusters of differentiation (CD). The three basic populations are helper, cytotoxic and regulatory T lymphocytes. T lymphocytes differentiate into effector cells and memory cells upon antigen activation. A characteristic feature of T lymphocytes is their constant circulation (blood, lymphatic organs and tissues).

### TCR (T Cell Receptor)

TCR is an antigen-specific receptor on T lymphocytes. Two forms are known: TCR $\alpha\beta$  and TCR $\gamma\delta$ . TCRs are always bound to membranes and recognize antigens bound to MHC molecules. They are always related to the CD3 complex. They are the somatically generated receptors.

### Titer

The titer is expressed as the reciprocal of the serum dilution that defines the endpoint. The serial dilutions of serum (in which antibodies are detected) is prepared and a constant amount of known antigen is added. The endpoint is the highest dilution of serum in which a visible agglutination with antigen is detected. If agglutination occurs in the tube with 1:160 dilution, the antibody titer will be 160.

### TLR (Toll-Like Receptors)

Toll-like receptors are preformed receptors on the surface of phagocytes and other host cells of immunity. They mediate a rapid response until the mechanisms of specific immunity are ready for response. They are stimulated by binding with antigens of microorganisms PAMP (for example, combinations of sugars, proteins, lipids and nucleic acids of microorganisms). After stimulation, TLRs mediate the initiation of defence responses, such as synthesis and secretion of cytokines that promote inflammation, attract neutrophils, macrophages, NK cells, and dendritic cells to the site of infection.

### Tolerance

Tolerance is the lack of response of the immune system to a particular antigen. Tolerance = selective unresponsiveness by lymphoid cells is applied in a situation where the immune system recognizes its own molecules, and a state of the destructive process does not occur. Immunological tolerance affects both antibody and cellular immunity and prevents the development of autoaggressive reactions. In the case of impaired tolerance, autoimmune



diseases develop. The development of immunological tolerance to self-antigens is a physiological phenomenon.

### **Tolerogen**

Tolerogen is a foreign antigen recognized by T or B lymphocyte that can induce immunologic tolerance.

### **Toxoid (anatoxin)**

Inactivated toxins called anatoxins or toxoids are no longer toxic but retain their immunogenicity so that they can be used for immunization (vaccination). Toxicity of toxin has been suppressed by chemical (formalin) or heat treatment. Toxins are secreted by bacteria, whereas toxoids are inactivated form of toxins and are not secreted by bacteria. Toxoids can elicit an immune response against the toxin. To increase the immune response, the toxoid is adsorbed to aluminium or calcium salts, which serve as adjuvants. Toxoid vaccines are safe because they cannot cause the disease they prevent and there is no possibility of reversion to virulence.

### **Transduction**

Transduction is the use of bacterial virus (bacteriophage) to transfer genes from one bacterial cell to another.

### **Transplantation**

Transplantation is a transfer of human cells, tissues or organs from one individual (donor) to another (recipient). It is the transfer of a tissue or organ from one place to another within one individual or transfer from one to another individual.

### **Transplantation rejection**

The transplanted organs or tissues can be rejected by the immune system. Rejection may lead to loss of function and removal of the transplanted organ or tissue.

### **Transplantation allogeneic**

Transplantation is performed between two genetically non-identical individuals of the same species (between genetically different individuals of the same animal species, e.g. brother and sister, parent and child).

### **Transplantation autogeneic (autotransplantation)**

Transplantation of autograft transferred from one part to another part within the same individual.

### **Transplantation syngeneic**

Transplantation is performed between different individuals who are genetically identical or nearly (e.g. twins).

### **Transplantation xenogeneic (xenotransplantation)**

Transplantation is performed between members of different species.

### **Thymus**

The thymus is the primary lymphoid organs, the site of T cells development.



### **Thymus-dependent**

Lymphoid cells that are dependent on the influence of the thymus. Thymus-dependent antigens induce immunoglobulin synthesis by B lymphocytes only with cooperation by T cells. The presentation of thymus-dependent antigens to T cells occurs in the cooperation with MHC class molecules. Humoral immune responses are associated with isotype switching and memory.

### **Thymus-independent**

Thymus-independent antigens induce synthesis of immunoglobulins by B lymphocytes without cooperation by T cells. They do not stimulate immunological memory. This type of immune responses to thymus-independent antigens shows only minor heavy chain isotype switching.



### **Urticaria**

It also called hives. Urticaria is a red, raised, an itchy skin rash that is sometimes triggered by an allergen. It is characterized by localized elevated, edematous, erythematous, and itching wheals with pale centres encircled by red flares. It is due to the release of histamine and other vasoactive substances from mast cells after degranulation of cytoplasmic granules. This process arises from immunological sensitization or physical or chemical factors. It is a form of type I immediate hypersensitivity mediated by IgE antibodies.

### **Uveitis**

Inflammation of the uvea, iris, ciliary body and choroid of the eye. Uveitis can be associated with Bechcet'disease, juvenile rheumatoid arthritis and some other autoimmune diseases.



# V

## **Vaccination**

Vaccination consists of stimulating the immune system with an infectious agent, or components of an infectious agent. This agent is modified in such a manner that no harm or disease is caused, but ensuring that when the host is confronted with that infectious agent, the immune system can adequately neutralize it before it causes any ill effect.

## **Vaccine**

A vaccine is a product that stimulates a person's immune system to produce immunity to a specific disease and protecting the vaccinated person from that disease. The main types of vaccines are live-attenuated, inactivated, subunit, recombinant, polysaccharide, conjugate and toxoid vaccines.

## **Vasoconstriction**

Vasoconstriction is narrowing of the blood vessels that results from the contraction of the muscular walls of the vessels. It is the opposite of vasodilation.

## **Vasodilation**

Vasodilation is the widening of the arteries and large blood vessels as a result of the relaxation of the blood vessel muscular walls. Vasodilation is a mechanism to enhance blood flow to areas of the body that are lacking oxygen or nutrients. The vasodilation causes a decrease in systemic vascular resistance and an increase in blood flow, resulting in a reduction of blood pressure.

## **VCA (viral capsid antigen)**

Viral capsid antigen is common in EBV infection, where the presence of antibodies in the IgM and IgG classes is demonstrated against it.

## **Virion**

A virion is a complete infective virus particle.

## **V<sub>H</sub> region**

V<sub>H</sub> region is the variable region (domain) of the immunoglobulin heavy chain.

## **V<sub>L</sub> region**

V<sub>L</sub> region is the variable region (domain) of the immunoglobulin light chain.



W

### **Western blot**

or Western blotting is a widely used analytic method to detect specific proteins in a sample. In Western blotting target proteins are separated by electrophoresis and transferred to a hydrophobic membrane and detected using specific antibodies.

### **Widal reaction**

Widal reaction is a specific reaction consisting in agglutination of *Salmonella typhi* or other salmonella species when mixed with serum from a patient having typhoid fever. The Widal reaction detects agglutinating antibodies against the O and H antigens of *Salmonella typhi*.



### **Xenograft**

The xenogeneic graft is a graft from a different species. Animals of different species are xenogeneic.

### **Xenogeneic transplantation (xenotransplantation)**

Transplantation is performed between members of different species (animals of different species are xenogeneic).

### **X-linked agammaglobulinemia**

see Bruton's disease



# Z

## **Zone of equivalence**

Zone of equivalence is the term that is used in the precipitation reactions *in vitro*. The zone at which the ratio of antigen to antibody is equivalent, the numbers of antigenic epitopes and antibody-binding sites are approximately equal.

## **Zone of antibody excess**

Zone of antibody excess is the part of the precipitin reaction curve, in which the number of antibody-binding sites is greater than the number of antigenic epitopes. Immune complexes form little or no precipitate.

## **Zone of antigen excess**

Zone of antigen excess is the part of the precipitin reaction curve, in which the number of antigenic epitopes is greater than the number of antibody-binding sites. Immune complexes form little or no precipitate.

## **Zymosan**

Zymosan is a polysaccharide derived from the cell wall of *Saccharomyces cerevisiae* yeast and activates the alternative pathway of complement.

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