

The immune system

The immune system (IS) maintains the integrity of the body; recognizes harmful from harmless and thus protects the body from exo- and endogenous pollutants. Together with the nervous system and the endocrine system, they belong to the regulatory systems.

Basic concepts:

- **Immunity** : protects the body against pathogenic microorganisms and their toxins.
- **Autotolerance** : recognizes one's own tissues.
- **Immune surveillance** : recognizes internal pollutants; removes old, damaged, mutated cells.
- **Antigens (Ag)**: substances that IS recognizes and responds to.

General characteristics of the immune system

Communication within the immune system

Communication between cells of the immune system takes place through signaling molecules :

- as direct interactions of molecules in membranes ,
- or via secreted molecules , including:
 - cytokines - protein molecules,
 - arachidonic acid derivatives (eicosanoids) - prostaglandins , leukotrienes , thromboxanes ,
 - NO ,
 - and more.

Typical characteristics of the functioning of the immune system

- A single signal usually has no response (the presence of costimulatory signals is required, otherwise it usually leads to attenuation).
- Signal amplification (the signal is amplified during the signal path).
- Presence of signal transduction systems (termination of the immune response).
- Cell proliferation (changes in cell number as needed).
- Diffuse arrangement (high probability of encountering a stimulus) + cell migration (will allow the response to be targeted where needed).

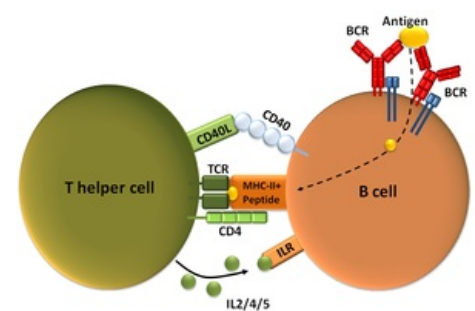
local specificity of the immune response

Immune reactions take place mainly in mesenchymal tissues. Every reaction is associated with damage to its own structures! If the stimulus is on the mucosa, there is usually a decrease. If something enters the submucosal ligament, it is likely to be pathogenic and the response will take place (see mucosal immune system). Immune-privileged areas are areas where some immune mechanisms are lacking. The immune response always damages the structures themselves, so these are areas with a low capacity for tissue regeneration (eg the CNS).

Allografts do not heal in immune-privileged areas .

Structure of the immune system

Innate immunity (also non- antigenically specific , congenital , non-adaptive)	cellular	phagocytes
		macrophages
		NK cells
Specific immunity (also acquired , adaptive)	humoral	complement
		interferons (IFN)
	Cellular	T-lymphocytes
	humoral	B-lymphocytes → [[antibodies]



B-cell activation by T-cell

Innate immunity

For more information see innate immunity.

Recognizes dangerous from harmless by PAMP (Pathogen-Associated Molecular Pattern) - phylogenetically conserved molecules that are typical of pathogens (eg viral RNA , lipopolysaccharide).

It cooperates with specific immunity (gives information about what is dangerous).

Specific immunity

 For more information see *Specific immunity*.

T-lymphocytes recognize only linear peptide fragments processed and presented by antigen presenting cells (APC), especially dendritic cells in the presence of costimulatory signals. They help non-specific immune cells kill pathogens.

B-lymphocytes recognize the native antigen and receive costimulation from T-lymphocytes.

Autoreactive lymphocytes are eliminated.

Specific immunity reacts only against dangerous stimuli (non-specific immunity and probably tissues that are damaged by the pathogen provide information about this). It has immunological memory (use in active immunization).

Major components of the immune system

Immune responses are provided by different types of cells and molecules and their interactions. Cells of the immune system + connective tissue cells → lymphatic tissue, lymphatic organs.

cells of the immune system

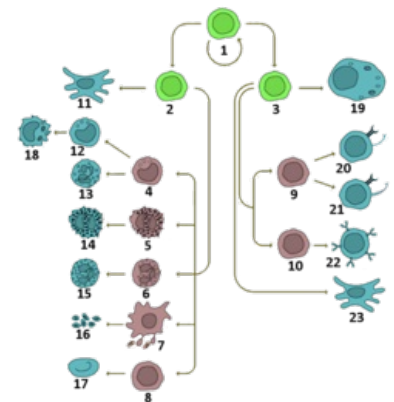
IS cells (immunocytes) = leukocytes , from bone marrow stem cells, having the adhesive molecule CD34. **2 baselines:**

1. Myeloid

- Monocytes (macrophages), neutrophils , basophils (mast cells), eosinophils , dendritic cells → non-specific component of IS; ability of phagocytosis , producers of cytokines , soluble mediators.
- Dendritic cells, monocytes and macrophages = antigen presenting cells (APC); basis and antigen-specific part of IS.
- The myeloid lineage also includes erythrocytes and platelets .

1. Lymphoid

- NK cells , B and T lymphocytes .
- B-cell development takes place in the bone marrow and is completed after encountering Ag in secondary lymphatic organs; the end stage is antibody -producing plasma cells .
- The development of T-lymphocytes takes place mainly in the thymus ; 2 main phenotypically distinct subpopulations: helper cell precursors (CD4 receptor surface), cytotoxic cell precursors (CD8): after encountering Ag on the surface of suitable APCs, they differentiate into mature effector T cells.
- After encountering Ag, some T and B lymphocytes differentiate into memory cells, which are then responsible for immunological memory.



Hematopoiesis

The basic molecules of the immune system

- TCR, BCR (antigen-specific receptors on the surface of T and B lymphocytes);
- MHC I., II. (HLA molecules);
- Fc receptors (bind Fc portions of immunoglobulin molecules);
- adhesive and costimulatory molecules;
- immunoglobulins;
- cytokines;
- components of the complement system

Physical barriers

- Easy renewal of surface layers (pathogens disappear together with epithelia).
- Various surface molecules, secretory antibodies (prevents adherence of pathogens).
- Commensal microorganisms (competing with pathogens).

Links

Related articles

- Innate immune system
- Specific immunity
- Mucosal immune system
- Antibodies

External links

- BUŇKY, POVRCHOVÉ MOLEKULY, ORGÁNY IMUNITNÍHO SYSTÉMU (http://fvl.vfu.cz/export/sekce_ustavy/mikrobiologie/imunologie/Prednasky/02_8_bunky_organy_bariery.pdf)

References

- HOŘEJŠÍ, Václav – BARTŮŇKOVÁ, Jiřina. *Základy imunologie*. 3. edition. Praha : Triton, 2008. 280 pp. ISBN 80-7254-686-4.
- KREJSEK, Jan – KOPECKÝ, Otakar. *Klinická imunologie*. 1. edition. Hradec Králové : Nucleus HK, 2004. 941 pp. ISBN 80-86225-50-X.