Skin immune system

The immune system of the skin is important for the protection against external agents, but at the same time it removes the dead, damaged or cancerous cells. A preserved, undamaged skin surface is necessary for its proper function.

Components of the skin immune system

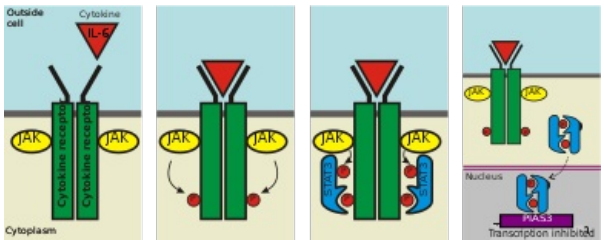
Cellular **(It works as a defense mechanism against intracellular bacteria, viruses, mycoses and cancer cells.)**	**Non-specific**	▪ Granulocytes (Neutrophils, Eosinophils, Basophils) ▪ Natural killer cells (NK cells) ▪ Mast cells (mastocyte)
	Specific	▪ T-lymphocytes
Humoral **(Defense against extracellular bacteria and toxins.)**	**Non-specific**	▪ Complement system ▪ C-reactive protein (CRP)
	Specific	▪ B-lymphocytes

Specific components of the skin immune system

The components of the **skin immune system** include granulocytes, endothelial cells of blood vessels, lymphatic capillaries of the *dermis* and the lymphatic vessels associated with draining the closest lymph nodes. All components work on the basis of close cooperation with the partial possibility of substituting one component for another. Cooperation is provided by **adhesive molecules** and **cytokines**.

Cytokines

Cytokines are signalling molecules that transduce important informations between cells and have the power over growth regulation, cell division differentiation, inflammation and immunity defense.[1] At the same time they are fundamental regulators of the immune system and for some goals is necessary to coordinate the influence of different cytokines - these synergic and antagonistic interactions between cytokines are called **cytokine net**. [2] Cytokines are present in the body dissolved in a liquid (plasma, tissue fluid) or conjuncted to a membrane (so called the membrane form).



Example of a cytokine receptor and its effect on the target cell (general scheme)

General characteristics of cytokines

- **Pleiotropia:** cytokines effect more than one type of cell (e.g. B-lymfocytes, mast cells),
- **Specificity:** the effect is typical only for a particular cytokine;
- **Redundancy:** some cytokines, for a change, can be replaced with others e e.g. IL-2 i IL-4 stimulates proliferation of B-lymfocytes;
- **Synergism:** effects of different cytokines complete each other;
- **Antagonism:** one cytokine enables the effect of another cytokine (e.g. IFN-γ blocks the switch to the synthesis of IgE, that induces IL-4[1]);
- Cascade effect: one cytokine induces the production of another cytokine.

The effects of cytokines, determined by the distance of the target, can be:

(see the picture on the right for particularities)

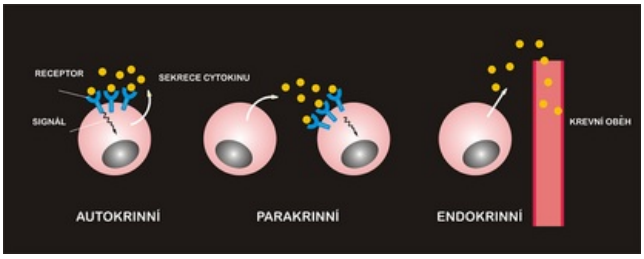
- **Autocrine,**
- **Paracrine,**

- **Endocrine.**

Receptors of cytokines

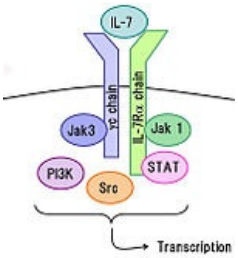
Cytokine's receptor are composed of two subunits (sometimes three):

1. the first subunit is needed for a specific cytokine bond (is deposited in the extracellular matter),
2. the second (eventually third) is needed for a junction with intracellular signalisation molecules.



Autocrine, paracrine and endocrine effect of cytokines

Signal transduction is allowed thanks to **protein kinase** (usually kinases of the group **How**). These kineses are non covalently joint to the intracellular part of the receptor. After the merge with a cytokine the kineses come closer together and activate each other. The activated enzymes phosphorylate other proteins and induce a cascade of reactions.



Receptor for IL-7 (example)

Beside protein kinases is important to mention **G-proteins** (sidenote: the Nobel Prize in Chemistry was awarded for the studies of the G-protein-coupled receptors in 2012 – Nobel Prize 2012 (https://www.nobelprize.org/?p=10071)). Receptors for chemokines (see below) are associated with G-proteins. The principle of function is different from the principle of protein kinases, but the outcomes are similar: change of enzyme activity, regulation of cell cykle, degranulation ect.

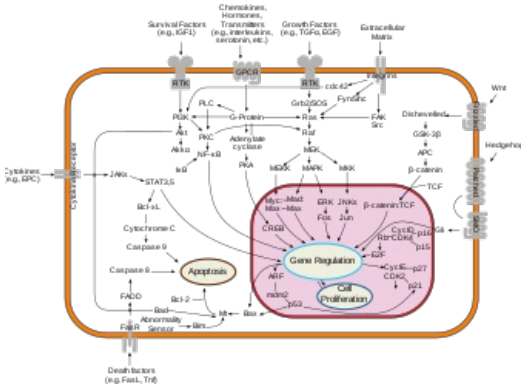
In the end exist some receptors (e.g. for FGF, EGF, TGF-β), that have in their cytoplasm space a kinase domain (so called **receptor kinase**).

Final signalisation outcomes depend on the receptor's type and on the cooperation of other signals. Almost anything can happen form the stimulation proliferation, passing through the change of activity ionic channels and membrane enzymes to the activation of apoptosis.

Classification [2]

Historically there were lymphokines and monokines (molecules produced by lymphocytes, monocytes), but is not that accurate and nowadays is not used anymore. Cytokines can be than divided in these groups:

- interleukines (regulate mostly leukocytes),
- chemokines (e.g. IL-8, have a characteristic activity),
- interferons (part of antivirus immunity),
- transforming growth factors (*transforming growth factors*, TGF) – TGF-α stimulates mitosis, TGF-β inhibits mitosis (structurally different molecules),
- colony stimulating factors (*colony stimulating factors*, CSF) – stimulate the differentiation of cells in bone marrow,
- tumor necrosis factors (*tumour necrosis factors*, TNF) – usually induce apoptosis,
- other growth factors – e.g. erythropoetin, FGF.



Signal transduction pathways – the role of cytokines in regulation of the cell cycle and apoptosis

Functional classification

This division is only approximative, but it provides at least a closer orientation in the confusing cytokine net:

- inflammation supporting cytokines (**pro inflammation**), chemokines included: TNF, IL-1, IL-4,IL-6, IL-8, IL-12,
- inflammation inhibiting cytokines (**anti inflammation**): IL-6, IL-10, TGF-β,
- cytokines with growth factor activity of hematopoetic cells: IL-2, IL-3, IL-4, IL-5, C-CSF, CD70, CD30L,
- cytokines fulfilling in **humoral immunity** (Th2): IL-4, IL-5, IL-9, IL-10, IL-13, TGF-β,
- cytokines fulfilling in **cell immunity** (Th1): IL-1, IL-2, IL-12, IL-15, IFN-γ, TNF,
- cytokines with antiviral effect: IL-28, IFN-α, IFN-β, IFN-γ.

References

Related articles

- Imunitní systém
- Funkce kůže
- Interferons
- Interleukins
- Colony stimulating factor
- Signal transmission in cells

External links

- Cytokines & Cells Online Pathfinder Encyclopedia (http://www.cells-talk.com/routingold/)

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2.

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