

# Immunology- lecture 1

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\*References:

- 1) immunology a short course (wisely-liss)
  - 2) medical immunology (for future reference)
  - 3) cellular of medical immunology (sovnders) also for reference
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## - *What is immunology ?*

Immunology is the study of the immunological response of the human body.

## - *why do we need immune system?*

\*\*you know as people living in this world ,we are living in a hostile environment ,there are lots of things like bacteria ,fungi ,viruses and parasites that live with us ,and if they have the chance, they will invade our body and colonize it for their benefit (they will use us as a medium causing infections; which are caused by microorganisms that colonize our body and use it as a medium and will lead to death unless the body responds to it ).\*\*

\*the immune system is a destructive system, it destroys, kills and causes damage. It is also an important system that differentiates between self and non-self antigens (it KILLS the non-self and DO NOT bother with the self).

One of the most important things of the immunological response is that your immune system should be able to recognize self from non-self antigens.

☆ In order to get an immune response ;first of all you should get a recognition ; your immune system must recognize that something is foreign and must be attacked then your body will respond

•there are 2 types of responses . A) immediate (in natural immunity ).

B) delayed (in acquired immunity).

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## TYPES OF IMMUNITY

A) Natural or non-specific or innate.

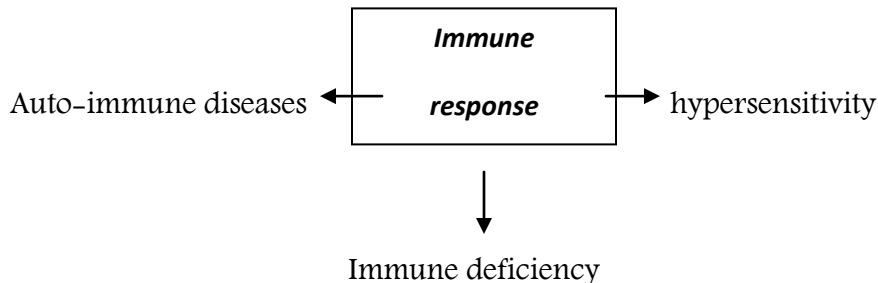
b) Acquired or specific or adaptive.

	Natural	Acquired
Onset	Immediate (recognition then response).	Delayed or proliferative response(recognition then there is a phase of delay that lasts for 5-7 days then we see the effect).
Specificity	Not specific at all.	Very specific against certain types of microorganisms.
Role	Considered the first line of defense ( invasion and killing effect but not enough to eradicate the infection). It limits the infection .	Eradication of the infection.
Efficacy	Less efficient.	More efficient.

\*after the eradication process the immune response must be shut off as it will lead to damaging effect on our own tissue.

**\*\*NOTE** .We can tolerate a certain amount of damage until getting rid of the microorganism, after that it MUST be shut off.

### Pathological abnormalities of the immune response



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1) **immune deficiency**; the immune response can be deficient, this can be either acquired ( like AIDS) or inherited ,in this case the immune system is not going to work which will lead to many types of infections that could be viral, bacterial...etc. according to the type of deficiency.

it mostly affects one branch of the immune system , very rare to affect the whole immune system.

2) **auto-immune**; the immune system in this case goes mad i.e. can't recognize the self from the non-self antigens, so the immune system starts to attack the body's tissues and cells e.g. RBC , WBC .

"we said that the recognition between the self and non-self antigens is very paramount (important), because we want to get rid of the bacteria and we don't want to damage our body".

3) **hypersensitivity**; in this case the immune response goes on (prolonged effect) unnecessarily ,sometimes for something that is not worth it like pollens.

Leading to damaging effect on our tissues.

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## •what is the immune response produced by?

We have cells that come from tissues then it will go and circulate through the blood.

\*\*\*The cells are the white blood cells

\*\*\*the tissues; there are tissues where the cells are produced (they are called **primary lymphoid/immune tissue**), and other where they live (they are called **secondary lymphoid/immune tissue**).

-bone marrow is considered as a primary lymphoid tissue

## \* *WBCs production site.*

-during embryogenesis; WBCs production occurs in the yolk sac, this function is taken over by the liver and by the time of birth this function (PRODUCTION OF WBCs) will be taken over by the bone marrow.

\*\*\*\*\*SO THE ONLY PLACE FOR WBCs PRODUCTION DURING ADULT LIFE IS THE BONE MARROW\*\*\*\*\*

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☆ Where are the site of BM that produce WBCS:?

Flat bones like the sternum ,ribs, vertebrae, and the ileum bone.

**NOTE; long bones contain FAT.**

## *-bone marrow cells maturation.*

Most of the cells that are produced from the BM mature there, however lymphocytes leave the bone marrow at a very early stage of maturation and they go into the blood where they have specific receptor for them at the high endothelial cells of the blood vessels of the thymus where they migrate into the thymus and continue their maturation and development ,they are called **T-LYMPHOCYTES**.

•**B-lymphocytes mature in the bone marrow.**

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## **Secondary lymphoid tissue :**

1)lymph nodes; they drain all parts of the body (anything in the subcutaneous tissue will go to the lymph nodes,they are present all over the body (e.g. arm,head,neck,bronchial,mesenteric,leg ...etc)

2)spleen; drains the blood (anything in the blood will go to the spleen)

3)mucosal associated lymphoid tissue (MALT); they are found under the mucosal surface (ex: under the membrane of intestine ,under the membrane of bronchial passages).

Those are the areas that are really exposed to the outside world, so under the epithelium we have suspensions of disorganized lymphoid tissue, we call them **MALT**.

•••**Peyer's patches ,tonsils , and adenoids are parts of the MALT** •••

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## -Cells of the immune system.

-in the bone marrow we have the stem cells that can divide endlessly and out of these divisions we get 2 main lines of development (the myeloid lineage and the lymphoid lineage).

\*\*we have a 3<sup>rd</sup> line of development which is called the erythroid lineage (produce RBC), but the doctor wants us to know the previous 2 .

### A) MYELOID LINEAGE; produce.

1) Megakaryocytes → they develop and produce platelets.

2) Eosinophils → contain basic granules so they take up the eosin dye and appear in red color.

3) Basophils → contain acidic granules so they take up the hematoxylin dye and appear blue in color,

They stay in the blood.

4) Neutrophils → 10-12 microns in diameter, pinkish-bluish granules (do not stain very well, there's no too much acid and no too much base), they are PNL (polymorphonuclear leukocytes) because its nucleus varies, some of them has 2 lobes, 3 lobes , 4 lobes.., they work as scavengers, they engulf foreign bodies and bacteria by process of phagocytosis and then become phagosomes that along with lysozymes form phagolysozymes where hydrolytic enzymes destroy the foreign body or the bacteria and also they destroy the neutrophil itself, then these hydrolytic enzymes are released causing injury to the surrounding tissues followed by death, leading to production of pus and this is what's called pyogenic infections.

-lysozymes are also present in body secretions like tears, saliva, gastrointestinal secretion, urine..

☆ Those are called granulocytes.

5) Mast cells → contain granules that are similar to basophils(They develop from similar line of development), however they stay in the tissue UNLIKE the basophils.

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6) mononuclear macrophages → they do not contain many granules, present in the blood and they have a large kidney shaped nucleus.

## B) LYMPHOID LINEAGE; produce.

- 1) T-lymphocyte } \*we can't distinguish between them under the microscope (histologically).  
2) B-lymphocyte } •under the microscope we only see the nucleus.

3) natural killer cells or large lymphocytes or large granular lymphocytes

\*they look like lymphocytes but they are paler and larger also they have more cytoplasm.

\*under the microscope we can see the cytoplasm; that's why they look larger

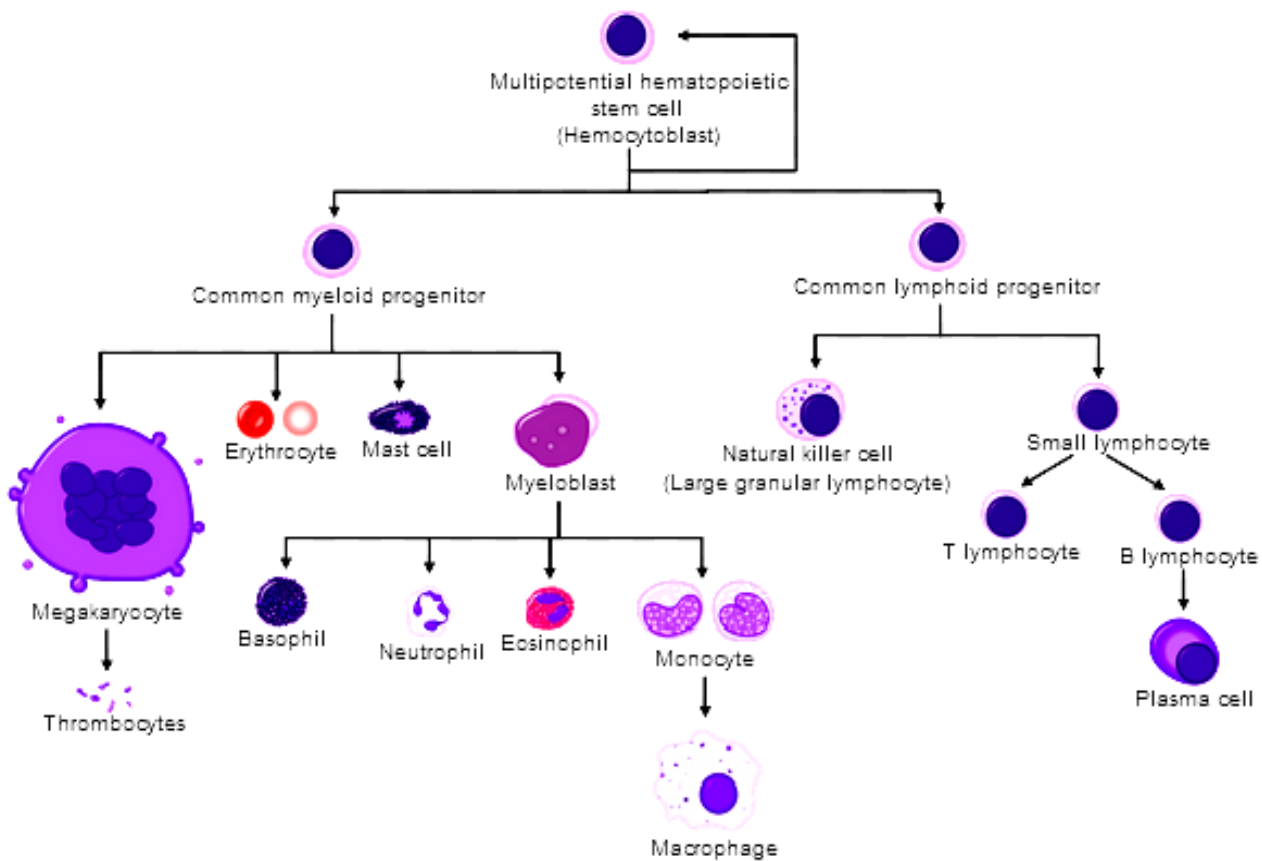
\*it constitutes about 10-15% of the lymphocytes.

## C) other type of cells :

-dendritic cells; contain dendrites; they are produced from the bone marrow from the 2 lineages (the myeloid & lymphoid lineage).

-follicular dendritic cells; also contain dendrites, these cells are found in the follicles of the lymph nodes, they come from the mesenchyme not the bone marrow.

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RBC are 5 millions in number.

\*white blood cells count :

\*\*About 4000-10000/m<sup>2</sup> out of these:

- 60% neutrophils (2/3 of our WBCs are actually neutrophils)

-<1% basophils

- 3% eosinophils

-7-8% monocytes (macrophages)

-30% lymphocytes (10-15% NK cells, 25% B-lymphocytes, the rest and the vast majority are the t-lymphocytes).

\* The eosinophils.

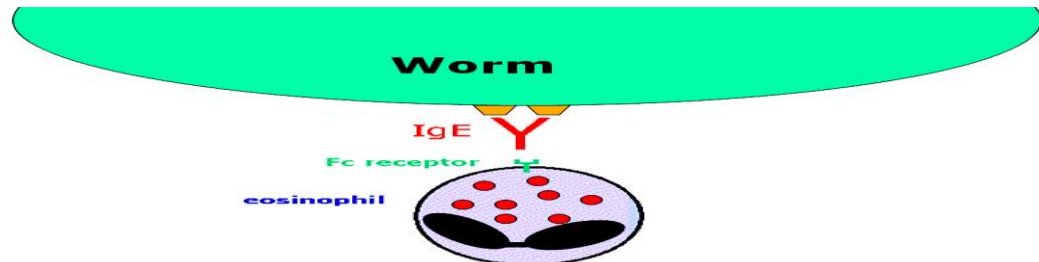
Red blood cells :7 microns

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-size: about 14 microns

-main content: basic protein that is very effective against parasites (it kills them).



-Contain receptors for antibody specifically IgE type (Y shape)

-if the antibody was attached to a parasite there will be degranulation of the eosinophils, the granules will be released and attack the parasite. Might cause eosinophilia like in infection with trichinella spiralis (eosinophils percentage in blood is 40%-very high)

So eosinophils are involved in killing the parasite (along with IgE) and might also produce allergic reaction.

**\*\*NOTE:** phagocytosis does not affect the parasite because they are really big.

**Note:** when we talk about the cells of the immune system we talk about the cells themselves and the molecules that are present on their surfaces, however we can't see those molecules using the microscope.

**\*\*In order to detect their presence we use antibodies against them.\*\***



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## *The CD nomenclature*

\*structurally defined leukocyte surface molecule that is expressed on cells of particular lineage and recognized by a group (cluster) of a specific antibodies is called a member of a cluster of differentiation(CD).

-they found that these molecules are not present all the time on the cell surface.

-the CD system is the basis of nomenclature of the CD molecules in the immunology.

-more than 200 types of CD molecules are identified.

-CD4 and CD8 are the most well known CD molecules.

-CD21 is complement receptor 2.

- what do CD molecules do? They serve a purpose; some of them transmit signals, some of them serve as adhesion molecules with other cells or with the matrix of the connective tissue, and some are communicating channels.