History of immune system

1718 – Lady Mary Wortley Montagu: observed the positive effects of variolation on the native population and had the technique performed on her own children.

- 1796 – Edward Jenner: First demonstration of vaccination smallpox vaccination
- 1857-1870 – Louis Pasteur: Confirmation of the role of microbes in fermentation
- 1891 – Robert Koch: Demonstration of cutaneous (delayed type) hypersensitivity
- 1896 – Jules Bordet: An antibacterial, heat-labile serum component (complement) is described
- 1900 – Paul Ehrlich: Antibody formation theory
- 1901 – Karl Landsteiner: blood groups
- 1908 - Metchnikoff (Phagocytoosis and cell-mediated immunity)
- 1959–1962 – Gerald Edelman and Rodney Porter: Discovery of antibody structure
- 1963 - Gell and Coombs: classification of hypersensitivity
- 1975 - Rolf Kiessling, Eva Klein and Hans Wigzell: Discovery of Natural Killer cells

Cellular components of immune system

Cells of immune system play an important role in the defense of body against foreign bodies; cells move in blood stream and lymph and can reside inside tissues. most of cells originate from hematopoietic stem cells originated in bone marrow and then differentiate into several types of cells including lymphocytes, red blood cells, platelets and phagocytic cells. Hematopoietic stem cells can differentiate into the following two major cells:

A - Lymphoid progenitor (generate non- granulated cells)

- T-lymphocyte (70% of total lymphocytes) (adaptive immune response)
- B-lymphocyte (20% of total lymphocytes) (adaptive immune response)
- Natural killer (NK) cells (10% of total lymphocytes)

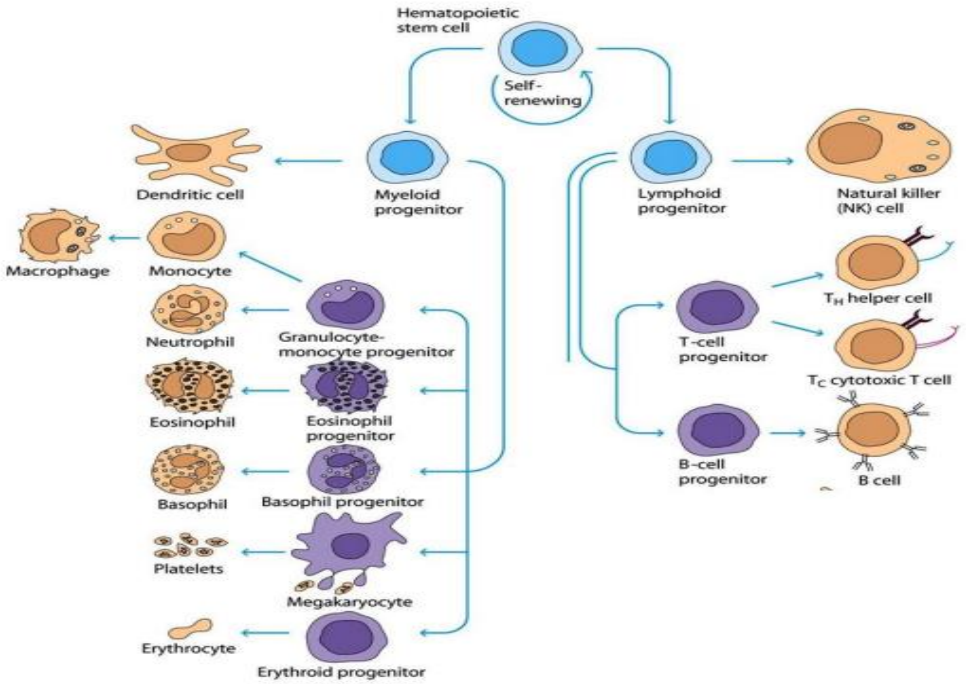
B- Myeloid progenitor (Myeloblast)

1-Granulocyte-Monocyte progenitor

- Neutrophil (polymorph nuclear neutrophils (PMNs), Eosinophil progenitor (generate eosinophil), Basophil progenitor (generate basophil), Monocyte (Macrophage)

2- Megakaryocytes: generates blood platelet (blood clotting and inflammations)

3-Erythroid progenitor: forms red blood cells (RBCs)



Lymphoid progenitor (adaptive immunity)

A- **Lymphocytes**: are the major cells responsible for adaptive immunity; constitute (around 20%) of leukocyte (white blood cells) in blood stream and recognize antigens through specific receptors. There two types of lymphocytes:

1- Small Lymphocytes:

a- T-lymphocytes: are derived from bone marrow and mature in thymus, the important cell of the immune system driven the formation of several type of immune cells including 1- recognize antigens presented by antigen presenting cells (APCs). 2-T cells recognize the antigens through T cell receptor (TCR). 3- There are four types of T cell: T-helper (Th) (CD4+), T-cytotoxic (Tc) (CD8+),

T-regulator (Treg) (CD4+, CD25, CTLA-4, FOXP3) and T-delayed type hypersensitivity (Tdth) (CD4+).

b- **B-lymphocytes**: derived and develop in bone marrow and differentiate after activation into plasma cell which in turn forms specific immunoglobulins in the blood stream and Formation of memory cells.

2- Large Lymphocytes

Natural killer (NK) cells (Innate immunity): are granulated lymphocytes and critical to innate immunity with nonspecific markers with (5-10%) in average of lymphocytes. They resemble large, granular lymphocytes morphologically related to T cells.

They do have two types of surface receptors, including an "**activating receptor**" that recognizes carbohydrate ligands and an "**inhibitory receptor**" that recognizes MHC class I molecules. - NKs play a role in antibody-dependent cellular cytotoxicity (ADCC) and other intracellular pathogens.

NKs functions including cytotoxic effect on virus-infected cells and respond to tumor formation because they are containing cytolysin and perforins (cytolytic proteins).

Myeloid progenitor (Innate immunity)

A- Neutrophils (PMNs): are the most numerous and constitute (around 60-70%) of granulated leukocyte in the blood stream, nucleus consist of (3–5) lobes and able to pigment with basic and acidic dyes, thus appear with purple color.

Neutrophils are the important cell of innate immune response because it is one of the first-responder inflammatory cells and migrate to the injury site and thus act as **the first line of body defense against foreign invaders**. The main function of neutrophils is phagocytosis.

Neutrophils have many types of cytoplasmic granules: azurophilic, lysozyme, protease and myeloperoxidase, colaginase, Gelatinize-containing granules.

B- **Eosinophil**: nucleus with 2 lobes and sausage-shaped and its cytoplasmic granules stained with red color because their ability to pigment with eosin dye. These ells constitute (2-3%) of leukocyte.

Responsible for the immune response against **parasitic worms** such as schistosoma due to containing antiparasitic agents such as cathepsin, peroxidase and histaminase.

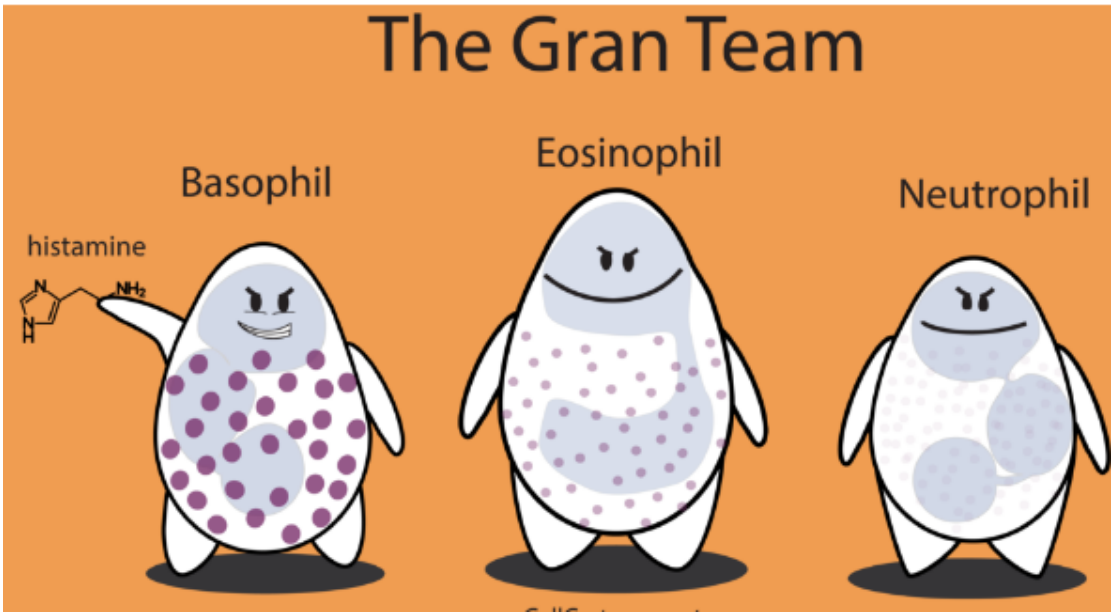
C-Basophil - Nucleus with S-shape and they are able to pigment with basic dyes and the cytoplasmic granules appear with blue color, constitute about (0.5-1%) of leukocyte. Release histamine and has Fc receptor for IgE, thus they are important in allergy symptoms and reactions. Basophile in tissues such as skin and connective tissues called **mast cells**

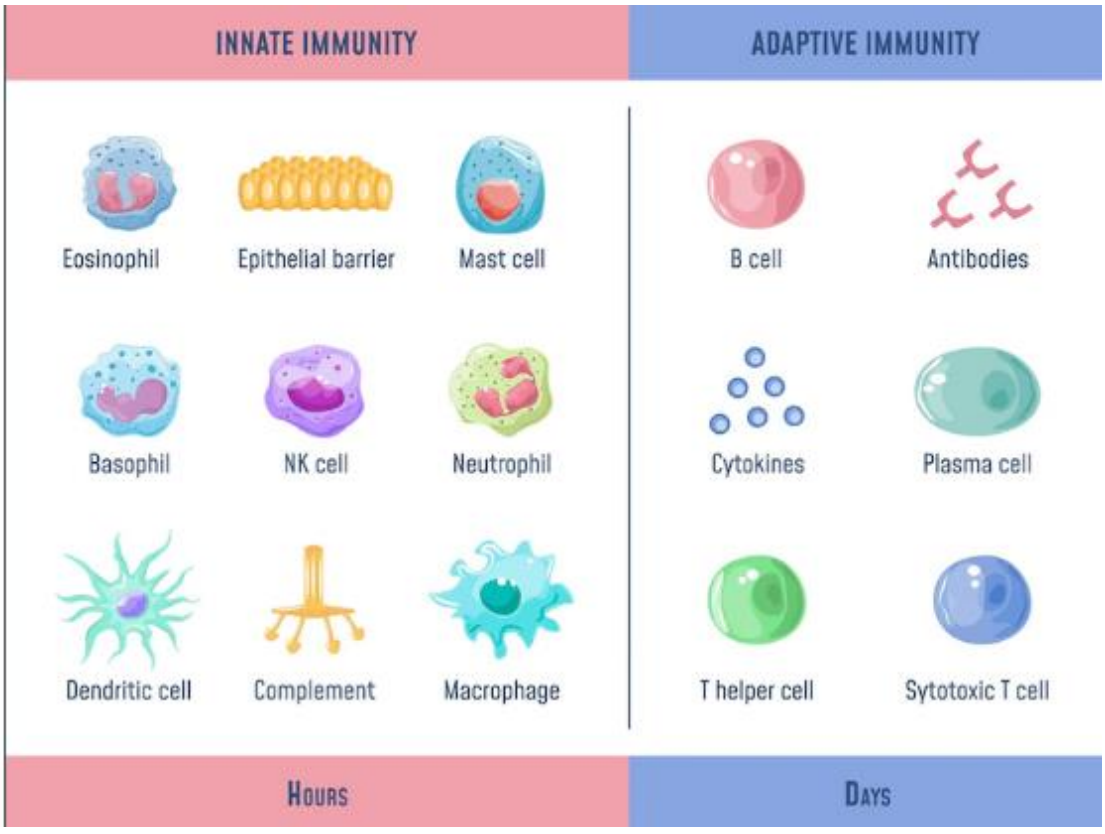
D-Monocyte-macrophage system: Non- granulated cells with kidney-shaped nucleus constitute (2-9%) of leukocyte, part of innate immune response, having Fc receptor for IgG antibody and c3b receptor of complement system.

Monocyte develop into **macrophage** in tissues; Macrophages have **several functions** including: 1- Scavenger of cellular debris 2- Phagocytosis 3- Antigen presenting cell (APC) 4- Initiation and regulation of immune response 5- Cytokines production. • Macrophage in tissues have different names depending on the tissues site.

E- Dendritic cells: are antigen-presenting cells (also known as accessory cells) of the mammalian immune system, present in those tissues that are in contact with the external environment, such as the skin (where there is a specialized dendritic cell type called the Langerhans cell) and the inner lining of the nose, lungs, stomach and intestines. They can also be found in an immature state in the blood. Once activated, they migrate to the lymph nodes where they interact with T cells and B cells to initiate and shape the adaptive immune response

Their main function is to **process antigen material and present it to the T cells of the immune system.** They act as messengers between the innate and the adaptive immune system.


The Gran Team
Basophil
histamine
Eosinophil
Neutrophil


INNATE IMMUNITY
ADAPTIVE IMMUNITY
Eosinophil
Epithelial barrier
Mast cell
B cell
Antibodies
Basophil
NK cell
Neutrophil
Cytokines
Plasma cell
Dendritic cell
Complement
Macrophage
T helper cell
Sytotoxic T cell
HOURS
DAYS