

Cells of the Immune System

Granular Leukocytes

Neutrophils

- Faster, smaller phagocytes (3-20 bacteria then die)
- Can't phagocytize anything larger than a bacteria
- Arrive to scene within one hour
- Turn into polymorphs as they get older.

Eosinophils

- Leave blood @ inflammatory sites
- Release histaminase (decreases histamine)
- Collect in tissue after allergic reactions
- Prevent spread of inflammation
- Detox inflammatory-inducing substances released by Mast/Basophils
- Phagocytizes antibody-antigen complexes
- Deactivates parasitic worms
- Secrete Histamine, LT, Cytokines, IL-4
- Involved in Late Phase Allergic Response

Basophils

- Become Mast Cells when leave the blood
- Leave blood at inflammation sites
- Live in areolar connective tissue near blood vessels, nerves and epithelium
- Release histamine, heparin, bradykinin, IL-4 and serotonin, which increases inflammation and allergic response.
- Cell membrane filled with IgE antibodies
- Involved in Late Phase Allergic Response

Agranular Leukocytes

Macrophages... "the Guardian cells"

- When wandering in the blood, called Monocyte (need to wander at least 8-10 hours). When "fixed" in an organ called:
 - Histocyte - connective tissue
 - Kupffer cells- liver
 - Alveolar macrophage - lung
 - Microglia - nervous system
 - Tissue macrophage - spleen, lymph, red bone marrow
- Phagocytic: kills 5x as many as Neutrophils and much larger. Can kill: RBC, malarial cells, parasites, necrotic cells and dead neutrophils.
- Attracts more neutrophils and macrophages to the area and stimulates them to increase killing

- When hypersensitized divide rapidly. Up to 10x more in allergic person during allergy season, returns to normal after season.
- Antigen Presenting Cell
- Stimulates B-cells, T-cells and Natural Killer Cell growth
- Decreases viral replication in uninfected cells
- Decreases tumor growth and formation
- Produces: Interleukin-1,5,6, Tumor Necrosis Factor, Transforming Growth Factor Beta, *alpha* and *beta* Interferon, Histamine, PG, LT, Thromboxane, PAF.

Lymphocytes:

Helper-T cells (CD4)... “the Managers”

- involved in Cell-Mediated Immunity
- Costimulates Cytotoxic-T's and B-cells to work more effectively
- Increase proliferation of Cytotoxic-T's, B-cells and NKC's
- Increase function of Macrophages and NKC's
- Attracts and activate phagocytes
- Alert uninfected cells of viral infection
- Shut down T's and macrophages at end of infection
- Produce: Interleukin 1,2,4,5; Transforming Growth Factor Beta, and *gamma* interferon

Cytotoxic-T-Cells (CD8)... “killer T's”

- Involved in Cell Mediated Immunity
- Kill virally-infected cells, fungi, cancer cells, transplanted cells, and invading parasites
- Poke holes in target cells and invading microbes
- Scramble DNA
- Attract and activate phagocytes and NKC's
- Prevent macrophages from leaving area
- Tightly controlled
- Require very strong MHC/Ag activation signal
- Produce: perforin, granulysin, granzymes, *gamma* interferon, lymphotoxin

B-Cells

- Involved in Antibody-Mediated Immunity
- Antigen Presenting Cells
- Fight against Exogenous Antigens (bacteria, bacterial toxins, inhaled pollen and dust, viruses that have not infected body cells yet, parasitic worms)
- Live in Lymph System
- Transform into Plasma cells which make antibodies (Immunoglobulins) that are able to leave lymph and enter blood

Antibodies ... “team Immunoglobulin” (Ig)

- Not really cells. Doubled chained proteins
- Made by B cells
- **IgG**: fights bacteria, viruses. Found in blood, lymph, and intestines. Can cross the placenta.
- **IgA**: found in sweat, tears, breast milk, and gastrointestinal secretions. Protects mucous membranes. Provides localized protection against bacteria and viruses. Stress decreases their production.
- **IgM**: first type of antibody to be released by plasma cells. Responsible for agglutination in improper blood transfusions. Found in blood and lymph.
- **IgD**: <0.2% of all antibodies. Found on B-cell as a receptor.
- **IgE**: receptor on Mast cells and Basophils. Responsible for allergic reactions. Protects against parasitic worms.
- **How they kill:**
 - **Neutralize** – block or neutralize bacterial toxins. Prevent some viruses from attaching to body cells.
 - **Immobilize** – attack flagella and cilia of bacteria.
 - **Agglutinate** – cross-link two pathogens together...phagocytes come in after and ingest agglutinated pathogens.
 - **Activate Complement**
 - **Enhance phagocytosis** - stem of antibody acts as “flag” for phagocytes. Also antibodies coat microbes so “stickier” for phagocytes to attach and ingest.

Natural Killer Cell (NKC)... “Poke and burners”

- Kills anything without a “me” flag (MHC)
- Kills tumors, melanomas, lymphomas and virally-infected cells
- Attracts and activates other phagocytes
- “hole-poker”
- destroys host cells missing a “me” flag
- kills host cell to release microbes for phagocytes to kill
- doesn’t need to conference with rest of immune system, but more effective if activated by CD4 (T-helper)
- produces: *gamma* interferon, perforin, granzymes