Shree H. N. Shukla Institute of Pharmaceutical Education and Research, Rajkot

B. Pharm
Semester-V

Subject Name: Pharmaceutical Biotechnology
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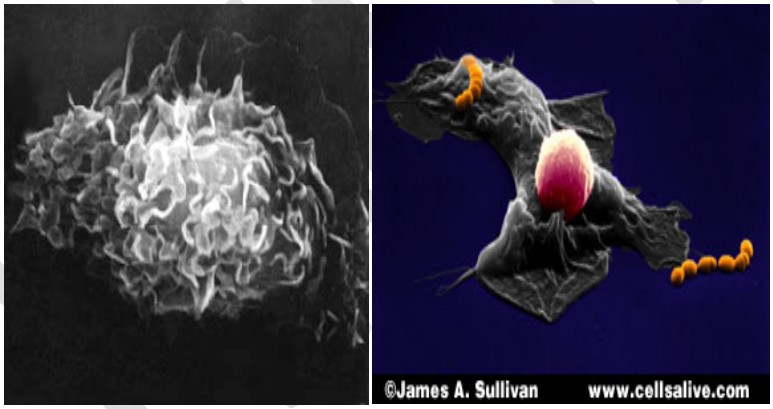
Chapter-3
TYPE OF IMMUNITY

Innate Immunity

- The innate immunity system is what we are born with and it is nonspecific; all antigens are attacked pretty much equally. It is genetically based and we pass it on to our offspring
- Surface Barriers or Mucosal Immunity
- The first and, arguably, most important barrier is the skin. The skin cannot be penetrated by most organisms unless it already has an opening, such as a nick, scratch, or cut.
- Mechanically, pathogens are expelled from the lungs by ciliary action as the tiny hairs move in an upward motion; coughing and sneezing abruptly eject both living and nonliving things from the respiratory system; the flushing action of tears, saliva, and urine also force out pathogens, as does the sloughing off of skin.
- Sticky mucus in respiratory and gastrointestinal tracts traps many microorganisms.

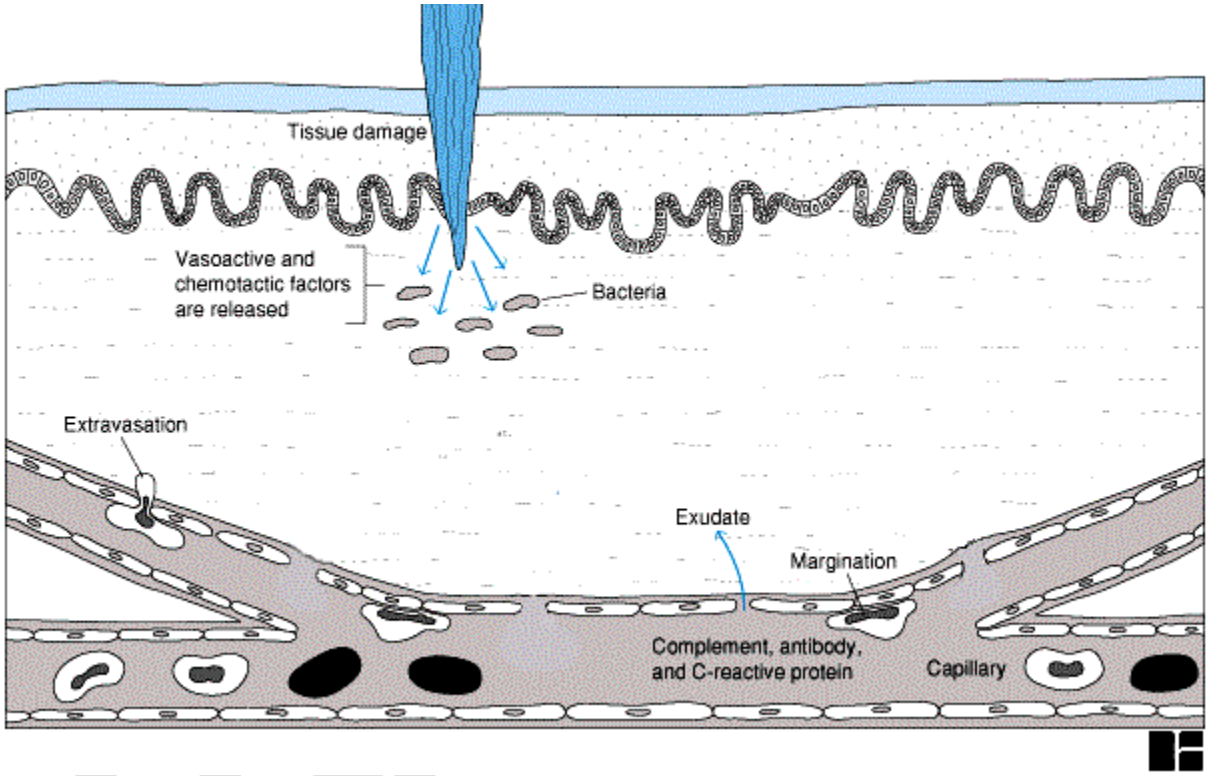
Phagocyte

- A phagocyte is a cell that attracts (by chemotaxis), adheres to, engulfs, and ingests foreign bodies. *Promonocytes* are made in the bone marrow, after which they are released into the blood and called circulating *monocytes*, which eventually mature into macrophages (meaning "big eaters", see below).



- **Macrophage system**
- **Some macrophages are concentrated in the**
- **lungs, liver (Kupffer cells),**
- **lining of the lymph nodes and spleen,**
- **brain microglia,**
- **kidney mesoangial cells,**
- **synovial A cells, and**
- **osteoclasts.**

- They are long-lived, depend on mitochondria for energy, and are best at attacking dead cells and pathogens capable of living within cells.
- Once a macrophage phagocytizes a cell, it places some of its proteins, called epitopes, on its surface—much like a fighter plane displaying its hits.
- These surface markers serve as an alarm to other immune cells that then infer the form of the invader. All cells that do this are called antigen presenting cells (APCs).



Other cells

- Natural killer cells move in the blood and lymph to lyse (cause to burst) cancer cells and virus-infected body cells. They are large granular lymphocytes that attach to the glycoproteins on the surfaces of infected cells and kill them.
- The complement system
- The complement system is a major triggered enzyme plasma system.
- It coats microbes with molecules that make them more susceptible to engulfment by phagocytes.
- Vascular permeability mediators increase the permeability of the capillaries to allow more plasma and complement fluid to flow to the site of infection.
- They also encourage polys to adhere to the walls of capillaries (margination) from which they can squeeze through in a matter of minutes to arrive at a damaged area.

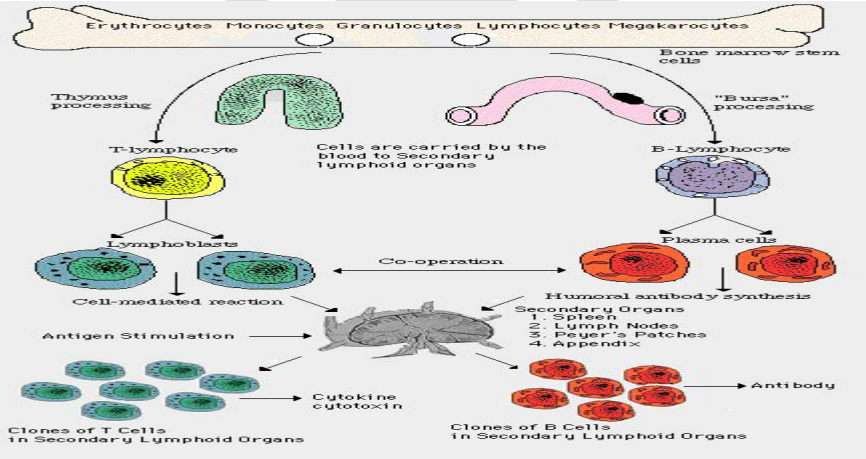
- Once phagocytes do their job, they die and their "corpses," pockets of damaged tissue, and fluid form pus.

Eosinophils

- Eosinophils are attracted to cells coated with complement C3B, where they release major basic protein (MBP), cationic protein, perforins, and oxygen metabolites, all of which work together to burn holes in cells and helminths (worms). About 13% of the WBCs are eosinophils. Their lifespan is about 8–12 days. Neutrophils, eosinophils, and macrophages are all phagocytes.

Dendritic cells

- Dendritic cells are covered with a maze of membranous processes that look like nerve cell dendrites.
- Most of them are highly efficient antigen presenting cells. There are four basic types:
- **Langerhans cells,**
- **interstitial dendritic cells,**
- **interdigitating dendritic cells, and**
- **circulating dendritic cells.**
- Our major concern will be Langerhans cells, which are found in the epidermis and mucous membranes, especially in the anal, vaginal, and oral cavities.
- These cells make a point of attracting antigen and efficiently presenting it to T helper cells for their activation.



Adaptive or Acquired Immunity

- Lymphocytes come in two major types:
- B cells and T cells.
- The peripheral blood contains 20–50% of circulating lymphocytes; the rest move in the lymph system.
- Roughly 80% of them are T cells, 15% B cells and remainder are null or undifferentiated cells.

- Lymphocytes constitute 20–40% of the body's WBCs**.**

Cell-mediated immunity

- Macrophages engulf antigens, process them internally, then display parts of them on their surface together with some of their own proteins.
- This sensitizes the T cells to recognize these antigens. All cells are coated with various substances.
- CD stands for cluster of differentiation and there are more than one hundred and sixty clusters, each of which is a different chemical molecule that coats the surface.
- CD8+ is read "CD8 positive." Every T and B cell has about 105 = 100,000 molecules on its surface.
- B cells are coated with CD21, CD35, CD40, and CD45 in addition to other non-CD molecules.
- T cells have CD2, CD3, CD4, CD28, CD45R, and other non-CD molecules on their surfaces.

T cells

- Cytotoxic or killer T cells (CD8+) do their work by releasing lymphotoxins, which cause cell lysis.
- Helper T cells (CD4+) serve as managers, directing the immune response.
- They secrete chemicals called lymphokines that stimulate cytotoxic T cells and B cells to grow and divide, attract neutrophils, and enhance the ability of macrophages to engulf and destroy microbes.
- Suppressor T cells inhibit the production of cytotoxic T cells once they are unneeded, lest they cause more damage than necessary.
- Memory T cells are programmed to recognize and respond to a pathogen once it has invaded and been repelled.

Humoral immunity

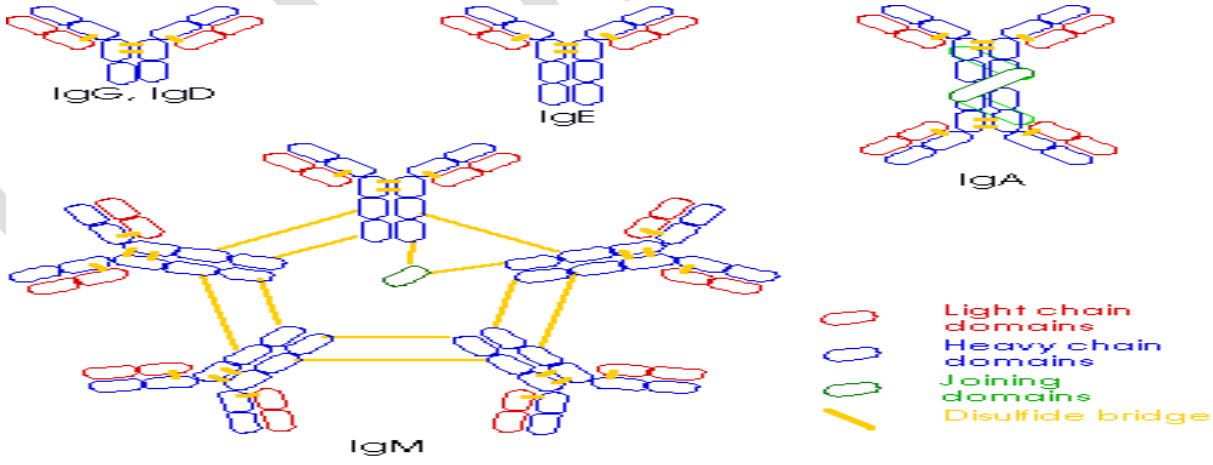
- An immunocompetent but as yet immature B-lymphocyte is stimulated to maturity when an antigen binds to its surface receptors and there is a T helper cell nearby (to release a cytokine).
- This sensitizes or primes the B cell and it undergoes clonal selection, which means it reproduces asexually by mitosis.
- Most of the family of clones become plasma cells.
- These cells, after an initial lag, produce highly specific antibodies at a rate of as many as 2000 molecules per second for four to five days.
- The other B cells become long-lived memory cells.

Antibodies

- Antibodies, also called immunoglobulins or Igs [with molecular weights of 150–900 Md], constitute the *gamma globulin* part of the blood proteins.
- They are soluble proteins secreted by the plasma offspring (clones) of primed B cells.
- The antibodies inactivate antigens by,
- (a) complement fixation (proteins attach to antigen surface and cause holes to form, i.e., cell lysis),
- (b) neutralization (binding to specific sites to prevent attachment—this is the same as taking their parking space),
- (c) agglutination (clumping),
- (d) precipitation (forcing insolubility and settling out of solution), and other more arcane methods.

Immunoglobulins

- Constituents of gamma globulin are: IgG-76%, IgA-15%, IgM-8%, IgD-1%, and IgE-0.002%
- IgG is the only antibody that can cross the placental barrier to the fetus and it is responsible for the 3 to 6 month immune protection of newborns that is conferred by the mother.
- IgM
- IgM is the dominant antibody produced in primary immune responses, while IgG dominates in secondary immune responses. IgM is physically much larger than the other immunoglobulins.



MHC molecules

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