Immunity

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Immunity is defined as the capacity of the bodyto resist pathogenic agents

Types

- Innate or inborn non specific
- Acquired or specific

Innate immunity

Inborn capacity of the body to resist pathogens

1. **Skin and mucus membranes-First line of defense**
   - Epidermis with keratinized cells in stratum corneum
   - Periodic shedding of epithelial cells
   - β-defensins,lysozyme in skin
   - Mucus membrane with hair cells in nose
   - With cilia in respiratory tract

2. Secretions from organs

- Sebum from sebaceous glands
- Sweat from sweat glands
- Tear from lacrimal apparatus withlysozyme
- Saliva- cleansingfunction,lysozyme
- Gastric juice –enzymes,high acidity
- Flow of urine
- Vaginal secretions-acidic

Second line of defense

1. **Anti microbial substances**
   - Interferons –proteins produced from virus infected lymphocytes,macrophages
   - Complement system- group of inactive proteins inplasma
   - Iron binding proteins-inhibit the growth of bacteria
   - Antimicrobial proteins-defensins, cathelicidins, dermicidin,thrombocidin

2.Nature killer cells

- 5-10% of lymphocytes in blood, spleen, lymph nodes, bone marrow

- They lack membrane molecules that identify B and T-lymphocytes
- They are non specific
- Release
    - Perforin-cytolysis
    - Granzymes-apoptosis

3. Phagocytes

Neutrophils

Macrophages

1. Wandering macrophages
2. Fixed macrophages
    - Histiocytes in connective tissue
    - kupffer cells in liver
    - Alveolar macrophages
    - Microglia in nervous system
    - Tissue macrophages in spleen,red bone marrow and lymph nodes

4.Inflammation

Non specific defensive response of the body totissue damage

- Rubor (redness)
- Tumor (swelling)
- Calor (heat)
- Dolor (pain

5.Fever

- Intensifies effect of interferons
- inhibit certain microbes
- speed up body reactions that aid repair

Acquired immunity or specific immunity

Resistance against specific invading agents

- Specifity
- Memory

Types of Acquired immunity

- Cell mediated immunity –by T lymphocytes
- Humoral immunity- by B lymphocyte

T lymphocytes

Processed in Thymus –just before birth and few months after birth

Stored in lymphoid tissues of lymph node, spleen, bone marrow and GIT.

Types

- Helper T cells-CD4cells
- Cytotoxic T cells- CD8 cells
- Suppressor T cells
- Memory T cells

B lymphocytes

Processing in liver (fetal life) and red bone marrow (adults)

Types

- Plasma cells
- Memory cells

Antigens (antibody generating substances)

Substances which provoke immune response

Types

1.Autoantigens (self antigens)

Eg: A antigen and B antigen in RBC

2.Foreign antigen or nonself antigen

Eg:Microbes, components of bacteria, egg white, pollen, transplanted tissues

Chemical nature

Conjugated proteins like lipoproteins, glycoproteins and neucleoproteins

Major histocompatibility complex

- Self antigens located in plasma membraneof body cells
- They are unique

Function

- Helps to recognize whether an antigen is self or non self

Types of MHC

MHC-1

Present in all body cells except RBC

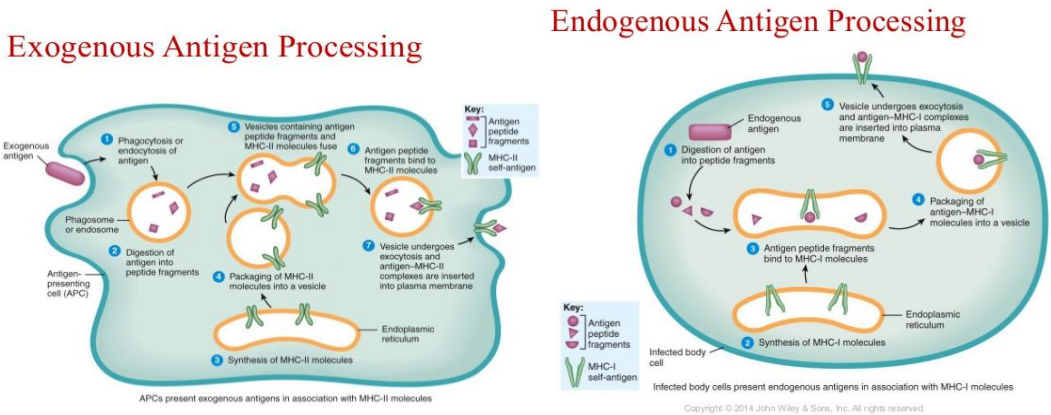
MHC-2

Present in antigen presenting cells

Antigen presenting cells

Special class of cells which process and present exogenous antigens

- Dendritic cells
- Macrophages
- B-lymphocytes

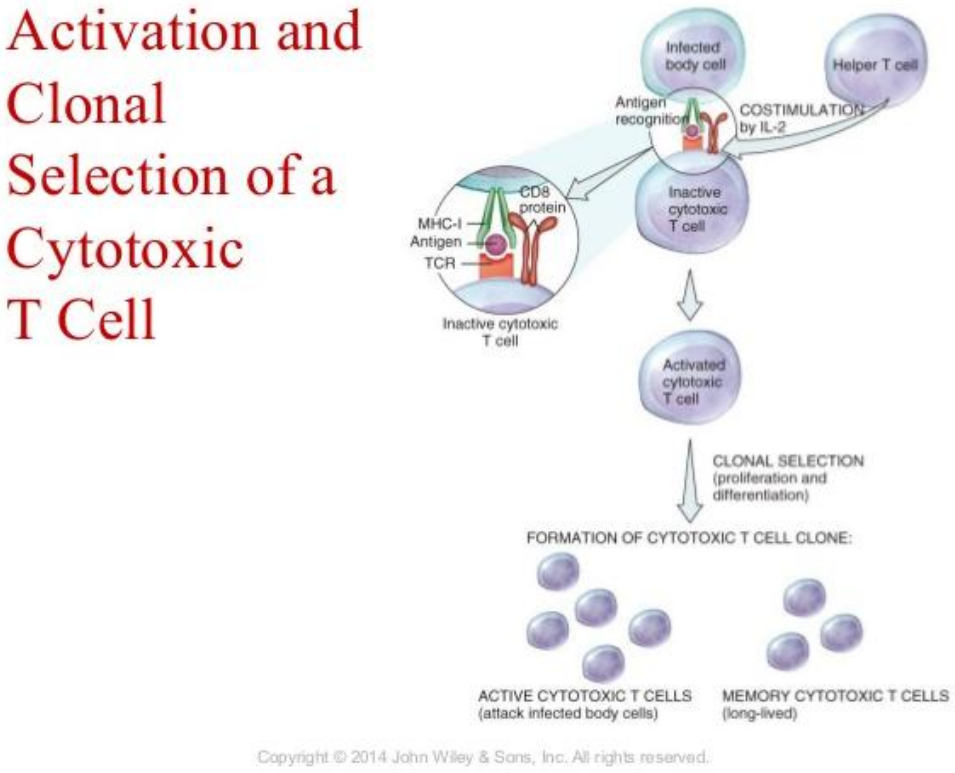


Cell mediated immunity

Effective against

- Intracellular pathogens
- Some cancer cells

- Foreign tissue transplant



Mechanism of action

- Granzymes –trigger apoptosis
- Protein from granules

Perforin-channels in cell membrane and cause cell bursting

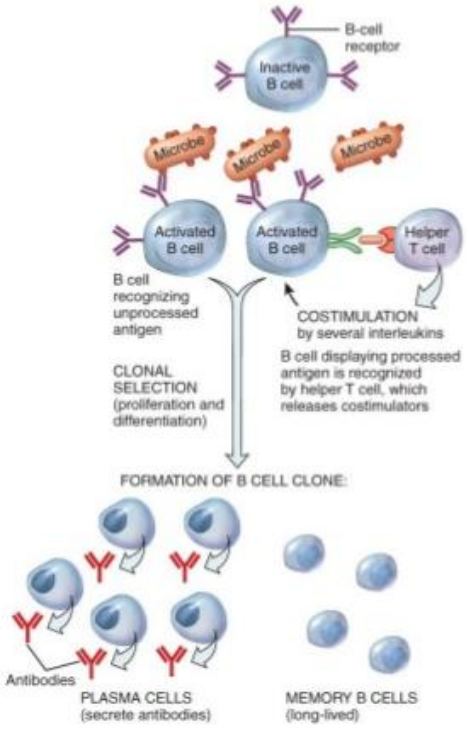
Granulysin – enter through chanels and produce holes in plasma membrane of micribes

Humoral immunity

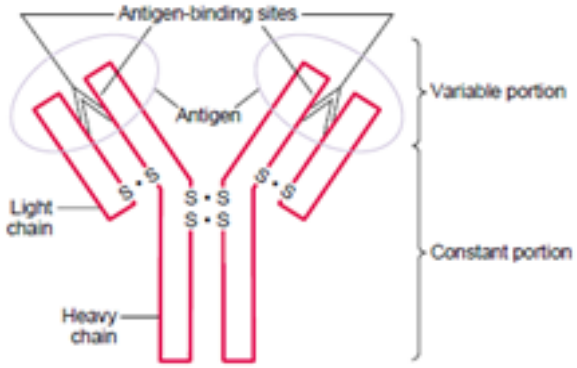
- Mediated by B-lymphocytes
- Against extracellular pathogens

Virus,bacteria or fungi outside the cells

Activation and Clonal Selection of a B Cells



Antibodies or immunoglobulins



Types

- IgA(alpha)
- IgD(delta)
- IgE(epsilon)
- IgG(gamma)
- IgM(mu)

1.**IgA**-15-20% (100-400mg/100ml)

- Major antibody in secretions of respiratory, gastrointestinal and genitourinary tracts
- Also inSaliva, tears,nasal secretion and human milk

2.IgD-3-4mg/100ml

- Present on surface of B-lymphocyte
- Receptor for antigen
- Exact function-unknown

3.IgE-0.03mg/100ml

- Binds to mast cells and basophils at Fc region and release of mediators
- Immediate hypersensitivity reactions

4.IgG-70-75%(900-1500mg/100ml)

- Secondary antibody response
- Can cross the placental barrier
- Important in immunity against bacteria and toxins

5.**IgM**-10% (50-200mg/100ml)

- First antibody to form
- macroglobulin

Mechanism of action

1.By direct action

- Agglutination
- Precipitation
- Neutralization
- Lysis

2.Through complement system

System of plasma enzymes identified by numbers C_1-C_9 including 3subunits of

C_1(C_{1q},C_{1r},C_{1s})- 11 enzymes

Enzymes of complement system are activated by

- Classical pathway
- Alternate pathway
- Lectin pathway

Classical pathway

C1 binds with antibodies and triggers series of events in which other enzymes areactivated in sequence.These enzymes or byproducts formed produce the followingactivities.

- Opsonization
- Lysis
- Chemotaxis
- Agglutination
- Neutralization
- Activation of mast cells and basophils

Alternate pathway

- Protein in circulation, factor I binds with polysacharides present in cell membrane of the invading organisms activates C3 and C5

Lectin pathway

- Mannose binding lectin which is a serum protein binds with mannose or fructose group on the wall of bacteria, fungi or virus

Cytokines

- Hormone like small proteins acting as intracellular messengers by binding to specific receptors of target cells

Secreted by

- WBCS and other type of cells

Types

- Interleukins-16 types
- Interferons-alpha,beta,gamma-antiviral
- Tumor necrosis factor-alpha,beta,gamma
- Chemokines
- Defensins-alpha,beta
- Cathelicidins
- Platelet activating Factor

For further reading

1. Principles of Anatomy and Physiology by Gerard J tortora and BryardDerickson
2. Textbook of human Physiology by SaradaSubramaniam and Madhavankutty