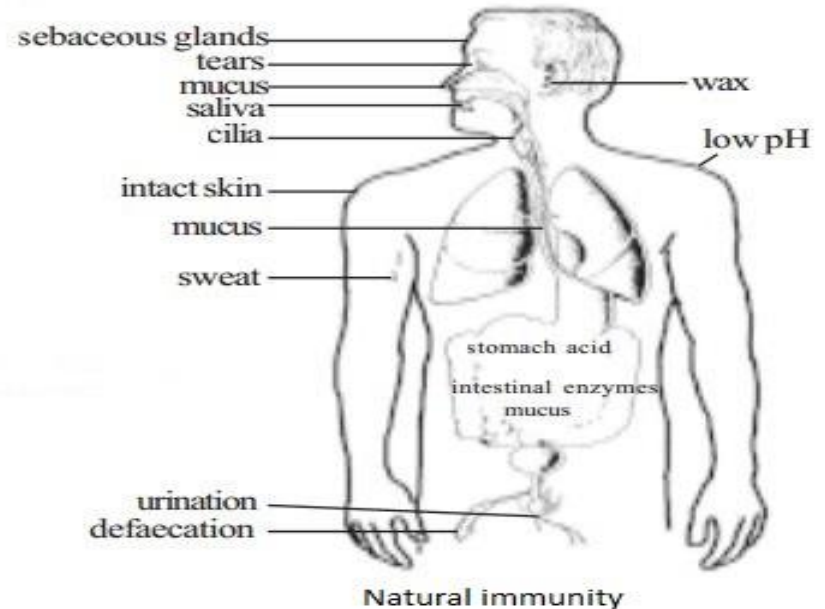


L2: Natural Defense

Objectives:

1. First (non-specific immunity) and second (adaptive immunity) lines of defense
2. Complement activation provides protection by killing pathogens
3. Accumulation of inflammatory cells important for clearance of infection
4. Cytokines as mediators regulate inflammation



Color Index:

Red = Important Notes Orange = Further Explanation Purple = Additional Notes Green = Examples Navy: boys notes

Defense Lines

NONSPECIFIC DEFENSE MECHANISMS		SPECIFIC DEFENSE MECHANISMS (IMMUNE SYSTEM)
First line of defense	Second line of defense	Third line of defense
<ul style="list-style-type: none">• Skin• Mucous membranes• Secretions of skin and mucous membranes	<ul style="list-style-type: none">• Phagocytic white blood cells• Antimicrobial proteins• The inflammatory response	<ul style="list-style-type: none">• Lymphocytes• Antibodies

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1st line of defence

2nd line of defence

First Line of Defense “Barriers”

Innate Immunity

Physical

- Skin, impermeable to microbes.
- Mucous membranes lining the gastrointestinal, genitourinary and respiratory tracts.
- Note :Some microbes attack the skin itself
- Note : Mucus has a biochemical barrier and it is considered as mechanical barrier

Mechanical

- Shedding of outer skin layers, Coughing and sneezing.
- Flushing of urine, Vomiting.
- Mucus & cilia in respiratory tract

Biochemical

- Body secretions contain anti-bacterial substances e.g. saliva, tears and sweat
- Antimicrobial peptides (e.g., defensins, hepcidins)
- Normal bacterial flora “Compete with pathogenic bacteria for nutrients”

Defensins is a protein produce by almost all epithelial tissues and neutrophils, and it has antibacterial activity against different types of gram-positive and gram-negative bacteria and to certain viruses and certain fungal elements
Hepcidins is in the circulation and have the same function as Defensins

Inflammation

Definition

Inflammation is the first response of the immune system to infection or irritation, it consists of a series of vascular & cellular changes that occur in response to various stimuli e.g. infections, injury, radiation

Microbial Infection Initiate inflammation

As bacteria possess any array of pro-inflammatory molecules such as "Lipopolysaccharide"

Goals of inflammation

- Prevent & limit infection and further damage
- Interact with adaptive immunity
 - "Monocyte/Macrophages serve as a link between adaptive and innate immunity by antigen presentation"
- Prepare the area of injury for repair

The Complement System

- Consist of a group of serum proteins circulate in blood and tissue fluids in **inactive** form once they become activated they produce important biological effects that initiate inflammation
- > 20 proteins, many are pro-enzymes
- This system plays an important role in Innate & Adaptive immunity.
- Initially inactive they are sequentially activated in a cascade
- Key protein is **C3** which is activated by C3 convertase

Pathways of Activation

Classical

Requires Antigen
Antibody reaction

C1,C4,C2,C3,C
5,C6,C7,C8,C9

Lectin

Activated by mannan
binding protein binding
manose groups of
bacterial carbohydrates

C4,C2,C3,C5,C
6,C7,C8,C9

Alternative

Activated by
bacterial products

C3,C5,C6,C7,C8,C
9

Notes :

- Membrane attack complex or lytic complex (C9) act is killing of pathogen.
- (C3b) is covering the pathogen and make it delicious for the phagocytic cells .

The Complement System

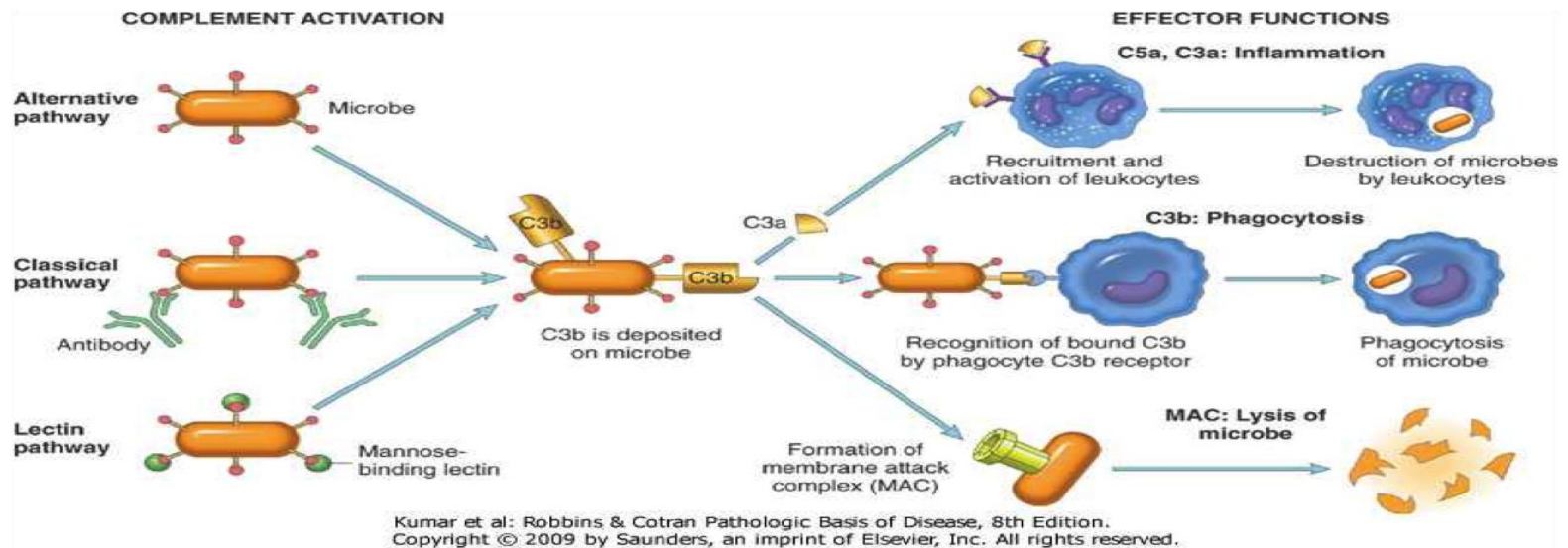
Biological effects of complement activation

Anaphylatoxin "C3a, C5a"

Induce Histamine release from mast cells and release chemotactic agents

Opsonization "Opsonin C3b"
Coating of bacteria enhances phagocytosis

Direct Cell Lysis
Destruction of bacteria



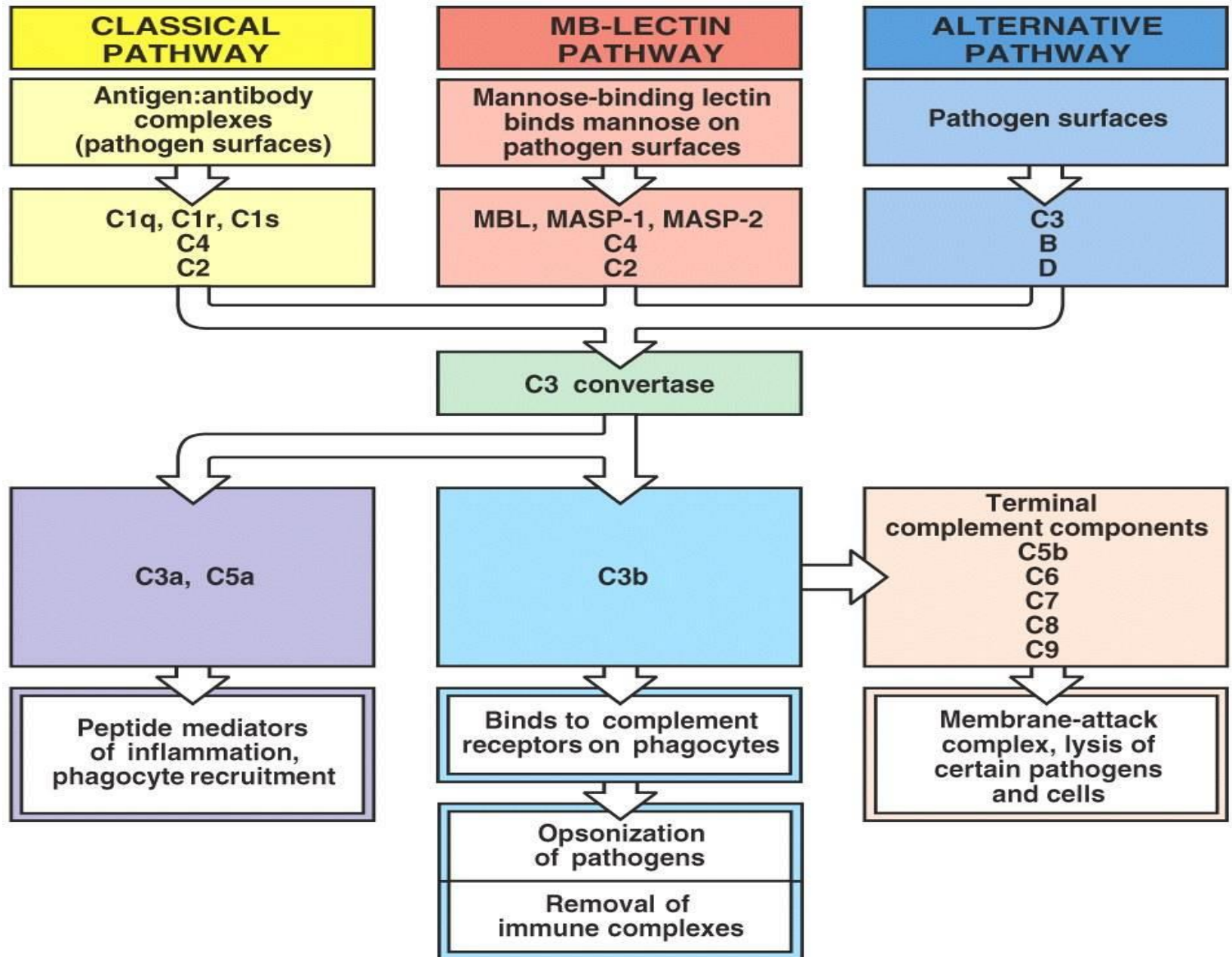
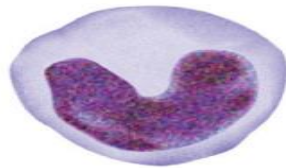


Figure 2-19 Immunobiology, 6/e. (© Garland Science 2005)

Defensive Cells

Types of Cells attracted to site of infection that mediate inflammation :



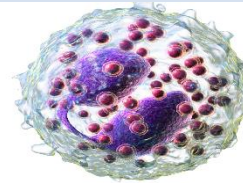
Monocyte

They become Macrophages when they leave blood and enter tissue



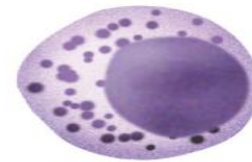
Neutrophil

Phagocytic Cell



Eosinophil

Allergy and Parasitic infections



Natural killer cell

Kill tumor cells and virally infected cells

Phagocytic cells (neutrophils & macrophages) at site of infection start the process of phagocytosis “ the process by which a cell ingests and destroy foreign material”

Cytokines

Definition

Soluble molecules, produced by different cells, that control cell functions e.g. activation or inhibition.

Interleukins

- Produced primarily by Macrophages and Lymphocytes in response to a pathogen
- **Examples**
- IL-1 “Inflammation, fever, production of IL-6, local tissue destruction”
- IL-6 “Induce fever, acute phase protein”
- IL-12 “Activates Natural killer cells, CD4 T helper cells”

Interferones

- Protects against viral infections.
- Produced and released by virally infected cells in response to viral infection.

Tumor Necrosis Factors TNF

- Secreted by Macrophages
- Induces fever by acting as an Endogenous Pyrogen “Substance released from inside the body that produces fever”
- Increases synthesis of inflammatory serum protein

Chemokines

- ❖ Class of cytokines with chemoattractant properties
- ❖ Recruit cells to sites of infection
- ❖ Interact with specific receptors
- ❖ Related in amino acid structure
- ❖ e.g:
- ❖ CXC
- ❖ CC

MCQS

1-Tumor necrosis factor (TNF) produces fever:

- A)True
- B)False

2-IL-12 activates immune cells which of the following does it activates:

- A)CD8+ cells,CD4+cells.
- B)Neutrophils ,macrophages.
- C) NK cells, CD4 T cells .
- D)NK cells ,neutrophils.

3-One of the following is not a goal of inflammation:

- A)Prevent and limit infection and further damage.
- B) Prepare the area of injury for healing.
- C) Interact with adaptive immune system.
- D) Damaging health tissue.

4 - Innate immunity acts as a second line of defense against pathogens

- A- T
- B - F

5 - which of these does not refer to (First line of defense)

- A - tears
- B - skin
- C - antibodies

6 - classical pathway requires

- A- carbohydrates
- B - Antigen - Antibody
- C - Activated by bacterial

7 - Complement system consist of a group of serum proteins circulate in blood and tissue in active form always .

- A - T
- B - F

8- key protein in the complement system is :

- A - C4
- B - C5
- C - C3

1-A
2-C
3-D
4-B
5-C
6-B
7-B
8-C

Thank you for checking our work

Done by:

- Amal Afrah
- Nada Alamri
- Ahmed Alsaleh

For any questions and suggestions connect us on
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