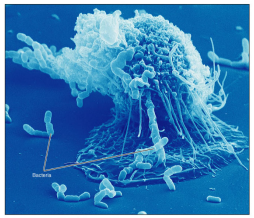
Slide 1

Non Specific Host Defense

Lecture 20

Slide 2

Learning Outcomes



- Physical and Chemical barriers to Infection
- White Blood Cells
- Inflammatory Response

Slide 3

Host Defenses

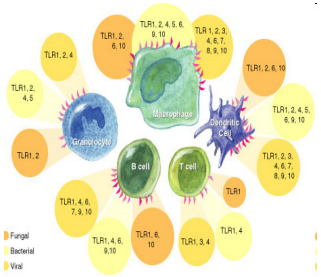
Nonspecific Resistance		Specific Resistance (Responses of the Immune System, Chapter 17)
First line of defense	**Second line of defense**	**Third line of defense**
• Intact skin • Mucous membranes and their secretions • Normal microbiota	• Phagocytic white blood cells • Inflammation • Fever • Antimicrobial substances	• Specialized lymphocytes: B cells and T cells • Antibodies

Figure 16.1

Slide 4

TLRs, PAMPs and Cytokines

- Toll-like Receptors
  - On plasma membranes of host white blood cells
- Pathogen-Associated Molecular Pattern
  - LPS of Gram –
  - Peptidoglycan of Gram +
  - Flagellin of motile bacteria
- Once TLR binds onto PAMP cell releases CYTOKINES
- Recruit phagocytes
- Activate T and B cells of adaptive immune system



Slide 5

Skin

- Epidermis consists of tightly packed cells
- Shedding
- Dryness and saltiness
- Keratin, a protective protein
- pH
- dermicidin

Slide 6

Mucous Membranes

- Cilliary escalator: Microbes trapped in mucus are transported away from the lungs
- Lacrimal apparatus: Washes eye
- Saliva: Washes microbes off
- Urine: Flows out
- Vaginal secretions: Flow out

Chemical Factors

- Fungistatic fatty acid in sebum
- Low pH (3-5) of skin
- Lysozyme in perspiration, tears, saliva, and tissue fluids
- Low pH (1.2-3.0) of gastric juice
- Transferrins in blood bind iron

Leukocytes

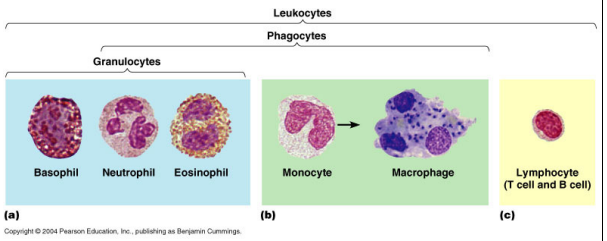


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Table 16.1

White Blood Cells

- Neutrophils: Phagocytic
- Basophils: Produce histamine
- Eosinophils: Toxic to parasites, some phagocytosis
- Monocytes: Phagocytic as mature macrophages
  - Fixed macrophages in lungs, liver, bronchi
  - Wandering macrophages roam tissues
- Lymphocytes: Involved in specific immunity

Differential White Cell Count

- Percentage of each type of white cell in a sample of 100 white blood cells

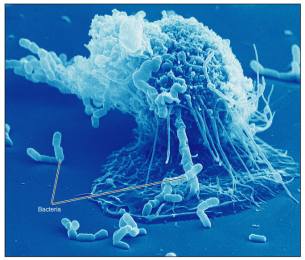
Neutrophils	60-70%
Basophils	0.5-1%
Eosinophils	2-4%
Monocytes	3-8%
Lymphocytes	20-25%

Monkeys and Bananas

- Never Let Monkeys Eat Bananas…
  - Neutrophil,
  - Lymphocyte,
  - Monocyte,
  - Eosinophil,
  - Basophil
- {Never Eat} [Bananas Like Monkeys] {granular}
- [agranular]

Phagocytosis

- *Phago*: eat
- *Cyte*: cell
- Ingestion of microbes or particles by a cell, performed by phagocytes



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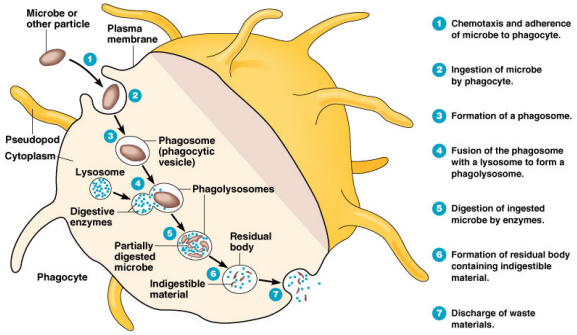
Phagocytosis



(a) Phases of phagocytosis

Figure 16.8a

Slide 14

Microbial Evasion of Phagocytosis

• Inhibit adherence: M protein, capsules	*Streptococcus pyogenes, S. pneumoniae*
• Kill phagocytes: Leukocidins	*Staphylococcus aureus*
• Lyse phagolysosome: Membrane attack complex	*Listeria monocytogenes, Trypanosoma cruzi*
• Escape phagosome	*Shigella, Rickettsia*
• Prevent phagosome-lysosome fusion	HIV, Chlamydia, Leishmania, Plasmodium
• Survive in phagolysosome	*Coxiella burnetti*
•Biofilms	*Bacteria cannot be ingested*

Inflammation

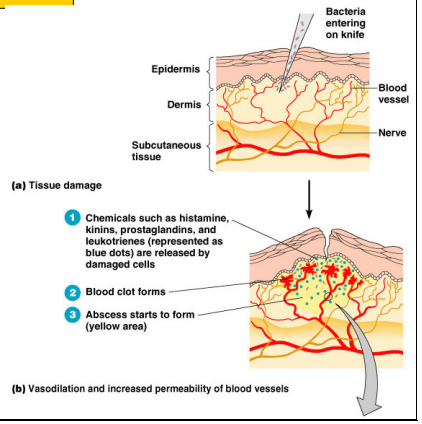
- Redness
- Pain
- Heat
- Swelling (edema)
- Acute-phase proteins activated (complement, cytokine, kinins)
- Vasodilation (histamine, kinins, prostaglandins, leukotrienes)
- Margination and emigration of WBCs
- Tissue repair

Chemicals Released by Damaged Cells

• Histamine	Vasodilation, increased permeability of blood vessels
• Kinins	Vasodilation, increased permeability of blood vessels
• Prostaglandins	Intensity histamine and kinin effect
• Leukotrienes	Increased permeability of blood vessels, phagocytic attachment

Slide 17

Inflammation



Slide 18

Inflammation

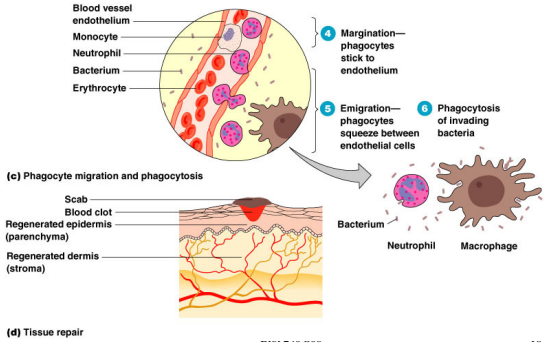


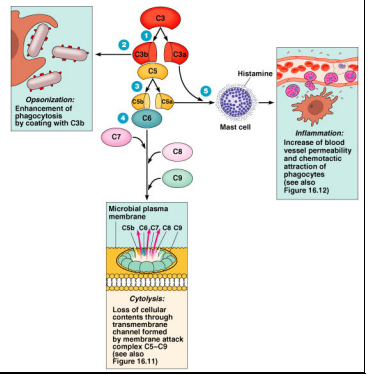
Figure 16.9c, d

Fever

- Systemic response
- Body increases rate of metabolism and shivering to raise temperature
- Chills are a sign that body temperature is rising
- When IL-1 is eliminated, body temperature falls. (Crisis)

The Complement System

- 30 Serum proteins produced in liver
- Circulate in blood
- Inactive until split
- Activated in a cascade.



Effects of Complement Activation

- Opsonization or immune adherence: enhanced phagocytosis
- Membrane attack complex: cytolysis
- Attract phagocytes
- Inflammatory response

Figure 16.11

Effects of Complement Activation

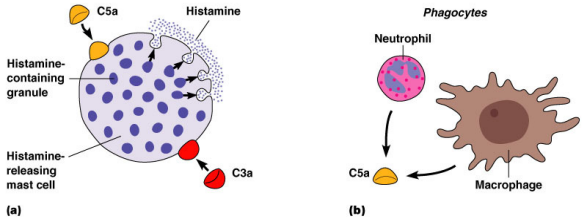


Figure 16.12

Some Bacteria evade Complement

- Capsules prevent C activation
  - Sialic acids
  - *Neisseria meningitidis*
- Surface lipid-carbohydrates prevent MAC formation
  - Serum resistant
  - Gram -
- Enzymatic digestion of C5a
  - Gram + cocci

Interferons (IFNs)

- Alpha IFN & Beta IFN: Cause cells to produce antiviral proteins that inhibit viral replication in neighboring cells
- Gamma IFN: Causes neutrophils and macrophages to phagocytize bacteria
- Antimicrobial Peptides
- Lysis of bacterial plasma membranes

Interferons (IFNs)

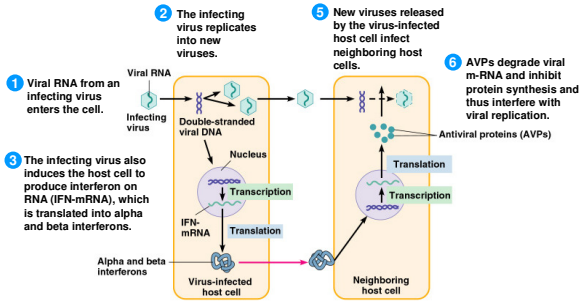


Figure 16.16