Chapter 16 Innate Immunity: Nonspecific Defenses of the Host

The concept of immunity
- Immunity – ability to protect against __________ from microbes and their __________
  - Includes protection against environmental agents such as pollen, drugs, chemicals, etc
  - Aka, ________________
- Susceptibility – ________________ or lack of ______________
- Two general mechanisms of immunity
  - ____________ (______________) immunity
  - ____________ (______________) immunity
- Adaptive Immunity
  - Involve recognition of ______________
    - Adapts of adjusts to fight a microbe
  - ________________ to respond than innate immunity
  - Has ________________ component
  - Involves white blood cells called “______________”
    - B cells, T cells
- Innate Immunity
  - Always present and available to provide rapid response
  - Does not involve ________________ of a microbe
  - Acts against ________________ in the __________ way
  - ____________ of defense include physical barriers
    - Skin, mucous membranes
  - ____________ of defense include cellular and molecular components
    - Inflammation, fever, phagocytic white blood cells
  - Early warning system to prevent ____________ of initial infection

FIRST LINE OF DEFENSE: Skin and mucous membranes

Physical factors
- Skin
  - Top layer is dead, __________ continually
    - Removes overlying microbes
  - No space in between skin cells, microbes can’t ______________
  - ________________ of skin inhibits most growth
    - In ________________ conditions, skin infections common
  - Keratin – protective ________________ in skin
    - Some fungi can hydrolyze keratin in skin
  - Most infections of skin are “______________” – below the skin
    - Through burns, cuts, stabs, breaks
- Mucous membranes
  - Inhibit ________________ of many microbes
    - Line GI tract, respiratory tract, genitourinary tract
  - Mucus – slightly ________________ fluid composed of ________________
    - ____________ invading microbes
    - Some pathogens can ____________ in mucus → Treponema pallidum
• Lacrimal apparatus
  o Manufactures and drains away _________
  o Continual ___________________ helps wash away microbes
• Saliva, urine cleanses like ______________
• _______________ in nose _________ inhaled air and traps microbes
• Cilia in respiratory tract move trapped microbes up into throat – “____________________”
  o _______________ and _______________ speed up process
• Defecation and _______________ also expel microbes

Chemical factors
• Sebum – _____ substance in skin produced by ____________ in skin
  o Forms ____________ film over skin
  o Contain unsaturated ______________ acids
    ▪ Inhibits growth of some pathogens and fungi, lower pH (pH ___________)
  o Some bacteria can _______________ sebum, lead to acne
• Sweat, or perspiration, contains lysozyme – _____________ that breaks down cell wall
  o Lysozyme also found in tears, saliva, tissue fluids, nasal secretions
• Gastric juice – mixture of _____________, enzymes, mucus found in ________________
  o Kills most bacteria and _______________
  o Some bacteria survive in food particles

• Normal protect microbiota via “_______________________________” (p. 424)

SECOND LINE OF DEFENSE

Formed elements in blood
• Formed elements – ________________________________ in blood
  o Leukocytes – __________________________ (__________ __)

Types of white blood cells
• Neutrophils
  o Highly _______________
  o Active in ________________ stages of infection
  o Can leave bloodstream and move into _______________ __ to fight infection
• Basophils
  o Release _________________, important in ________________
• Eosinophils
  o Produce toxins against ___________________________, such as helminths
    ▪ Attach to outer surface in _____________, destroy membranes
  o ________________ in ________________ during parasite infection
  o Can _________________, move into tissue
• Dendritic cells
  o Destroy microbes by _______________
  o Activate _________________ immune response
• Monocytes
  o Not ________________ in _________________
  o Can move into tissue, mature into “____________________”
    ▪ Highly ___________________
• Lymphocytes
  o Natural killer (NK) cells, T cells, B cells
  o NK cells kill _____________ cells, _______________ cells
    ▪ Any cell that displays “_______________” plasma membrane proteins
    ▪ Kills only cell, not microbe inside
  o T cells, B cells play key role in ___________________________

• Leukocytosis – ______________ in ________________ ______ in response to infection
  o Can double, triple, quadruple
• Leukopenia – ________________ in ________________ ______ in response to infection
  o Due to impairment of white blood cell _________________. _______________
• Differential white blood cell count – ________________ of WBC in blood

Phagocytes
• Phagocytosis – ingestion of ________________ or ________________ by a cell
• Phagocytes – ______________ that perform ______________
  o Neutrophils, macrophages, dendritic cells

Actions of phagocytic cells
• During infection, ________________ and ________________ (macrophages) migrate to infected area
  o Highly phagocytic
• As infection progresses, ________________ dominate
  o Clean up remaining live bacteria, clear up dead cell ________________

The mechanism of phagocytosis
• 4 main phases of phagocytosis
  o Chemotaxis, adherence, ingestion, digestion
• Chemotaxis – chemical ______________ of phagocytes to microbes
  o Attracted to microbial products, damaged tissue cells, various chemicals
• Adherence – ________________ of phagocyte’s plasma membrane to microbe
• Ingestion – ________________ of microbe via plasma membrane
  o Projections of plasma membrane called “_______________”
  o Microbe internalized in vesicle called ________________
    ▪ Inside is acidic, pH 4
• Digestion – ________________ of microbe
  o Phagosome fuses with lysosomes → ________________
    ▪ Lysomes contains many enzymes that ________________ bacteria
    ▪ Takes 10 to 30 minutes
  o ________________ material expelled from cell

Microbial evasion of phagocytosis
• Inhibition of ________________
  o If phagocytes cannot ________________, can’t phagocytose
  o M protein of S. pyogenes, capsules of S. pneumoniae
• Some are phagocytosed, but ________________
  o Leukocidins and streptolysins kill phagocytes
• ______________ from phagosome
  o Produce “membrane attack complexes”
  o Live and replicate ____________ phagocyte
  o Can escape from phagocyte by ______________ cell
  o Listeria monocytogenes, Trypanosoma cruzi
• Survival inside ______________
  o Coxiella burnetti requires ______________ inside ______________ to replicate
  o Mycobacterium tuberculosis can prevent fusion of phagosome

Inflammation
• ______________ response to infection
• Characterized by redness, pain, heat, swelling
• Acute inflammation – ______________, ______________
  o Cause of inflammation ______________
  o Boils caused by S. aureus
• Chronic inflammation – ______________ lasting, less intense
  o Cause of inflammation ______________
  o Tuberculosis caused by M. tuberculosis
• Functions:
  o To ______________ the injurious agent
  o Limit the effects on body by __________ injurious agent
    ▪ Occurs if destruction, removal not possible
  o ______________ or replace damaged tissue

Stages of inflammation
• Vasodilation and increased permeability of blood vessels
  o Tissue damage results in vasodilation, increase in permeability of blood vessels
  o Vasodilation – ______________ (increase in diameter) of blood vessels
    ▪ Increases ______________ to area
    ▪ Responsible for “____________” (redness), ______________
  o Increased permeability allows WBC, chemicals to pass from ________ to injured area
    ▪ Responsible for “____________” (swelling)
  o ______________ release in response to injury
    ▪ Released by ______________ cells, ______________
  o Blood clots around injury prevents ______________
• Phagocyte migration and phagocytosis
  o Blood flow eventually brings ______________ to site of infection
    ▪ ______________ invading microorganisms
  o In response to bacteria, neutrophils first, followed by monocytes
  o ______________ often die after killing many cells
    ▪ Cell debris contribute to ______________
• Tissue repair
  o Replacement of ______________ or _______________ cells
  o Speed of repair depends on tissue
    ▪ Skin heals fast, cardiac (heart) muscle heals slow
Fever
- Fever – an __________________ temperature
- __________________ response to infection
- Most commonly caused by ________________, ______________ infections
- Certain chemicals trigger a “__________________” of body “thermostat” to a __________ temperature
  - __________________
- Chill – response to ______________ body temperature
  - Skin remains cold, shivering, increased metabolism, constriction of blood vessels
- Crisis – response to ______________ body temperature
  - Skin gets warm, perspiration, vasodilation
- Fever is helpful up to certain degree
- Helps increase ______________ production, metabolism, ______________ repair, etc …
- Complications include:
  - ______________ – rapid heart rate, may compromise weak hearted
  - Increased ______________ – dehydration, electrolyte imbalance, acidosis
  - ______________ in young children
  - Delirium
  - Coma
  - __________ °C (____________ °F) = death

Antimicrobial substances
Complement system
- Complement system – defensive system consisting of ________________ in blood
- Destroy microbes by:
  - ________________ (___________________) of bacteria
  - Triggering ______________
  - Helping with ______________

Evading complement system
- Some capsules prevent complement ________________
- Some gram-negative bacteria can lengthen surface glycolipids to prevent ________________
  - “_____________-resistant”
- Some gram-positive cocci release ________________ that ______________ complement proteins

Interferons
- Interferons – antiviral ________________ produced by ________________ cells
  - ________________ with viral ________________
- Effective against ________________ of viruses
- Protect ________________ cells by causing them to produce “______________” (AVP)
  - ________________ that inhibit ________________ of viral particles
- Effective for ________________
  - Important in acute viral infections (colds, flu)
- ________________ are toxic to heart, liver, kidneys, bone marrow
- Some viruses can inhibit AVP
  - Adenoviruses – respiratory infections
• Some (Hepatitis B virus) do not induce a great interferon response
• Can serve as potential ____________ drugs, ____________ drugs

Antimicrobial peptides
• Newly discovered, may be most important component of ________________ immunity
• Small _______________
  o 10 – 20 amino acids
• Bind to __________________________ causing cell lysis
• Produced by ______________________ and ______________