

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 or 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
 - Manufactures and drains away _____
 - 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 – “_____”
 - _____ and _____ speed up process
- Defecation and _____ also expel microbes

Chemical factors

- Sebum – _____ substance in skin produced by _____ in skin
 - Forms _____ film over skin
 - Contain unsaturated _____ acids
 - Inhibits growth of some pathogens and fungi, lower pH (pH _____)
 - Some bacteria can _____ sebum, lead to acne
- Sweat, or perspiration, contains lysozyme – _____ that breaks down cell wall
 - Lysozyme also found in tears, saliva, tissue fluids, nasal secretions
- Gastric juice – mixture of _____, enzymes, mucus found in _____
 - Kills most bacteria and _____
 - Some bacteria survive in food particles
- Normal protect microbiota via “_____” (p. 424)

SECOND LINE OF DEFENSE

Formed elements in blood

- Formed elements – _____ in blood
 - Leukocytes – _____ (_____)

Types of white blood cells

- Neutrophils
 - Highly _____
 - Active in _____ stages of infection
 - Can leave bloodstream and move into _____ to fight infection
- Basophils
 - Release _____, important in _____
- Eosinophils
 - Produce toxins against _____, such as helminths
 - Attach to outer surface in _____, destroy membranes
 - _____ in _____ during parasite infection
 - Can _____, move into tissue
- Dendritic cells
 - Destroy microbes by _____
 - Activate _____ immune response
- Monocytes
 - Not _____ in _____
 - Can move into tissue, mature into “_____”
 - Highly _____

- Lymphocytes
 - Natural killer (NK) cells, T cells, B cells
 - NK cells kill _____ cells, _____ cells
 - Any cell that displays “_____” plasma membrane proteins
 - Kills only cell, not microbe inside
 - T cells, B cells play key role in _____
- Leukocytosis – _____ in _____ in response to infection
 - Can double, triple, quadruple
- Leukopenia – _____ in _____ in response to infection
 - 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 _____
 - Neutrophils, macrophages, dendritic cells

Actions of phagocytic cells

- During infection, _____ and _____ (macrophages) migrate to infected area
- _____ increase in initial stages of _____ infection
 - Highly phagocytic
- As infection progresses, _____ dominate
 - Clean up remaining live bacteria, clear up dead cell _____

The mechanism of phagocytosis

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

Microbial evasion of phagocytosis

- Inhibition of _____
 - If phagocytes cannot _____, can’t phagocytose
 - M protein of *S. pyogenes*, capsules of *S. pneumoniae*
- Some are phagocytosed, but _____
 - Leukocidins and streptolysins kill phagocytes

- _____ from phagosome
 - Produce “membrane attack complexes”
 - Live and replicate _____ phagocyte
 - Can escape from phagocyte by _____ cell
 - *Listeria monocytogenes*, *Trypanosoma cruzi*
- Survival inside _____
 - *Coxiella burnetii* requires _____ inside _____ to replicate
 - *Mycobacterium tuberculosis* can prevent fusion of phagosome

Inflammation

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

Stages of inflammation

- Vasodilation and increased permeability of blood vessels
 - Tissue damage results in vasodilation, increase in permeability of blood vessels
 - Vasodilation – _____ (increase in diameter) of blood vessels
 - Increases _____ to area
 - Responsible for “_____” (redness), _____
 - Increased permeability allows WBC, chemicals to pass from _____ to injured area
 - Responsible for “_____” (swelling)
 - _____ release in response to injury
 - Released by _____ cells, _____
 - Blood clots around injury prevents _____
- Phagocyte migration and phagocytosis
 - Blood flow eventually brings _____ to site of infection
 - _____ invading microorganisms
 - In response to bacteria, neutrophils first, followed by monocytes
 - _____ often die after killing many cells
 - Cell debris contribute to _____
- Tissue repair
 - Replacement of _____ or _____ cells
 - 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 _____
 - 10 – 20 amino acids
- Bind to _____ causing cell lysis
- Produced by _____ and _____