

Chapter 15 Microbial Mechanisms of Pathogenicity

Overview

Portals of Entry

Penetrating Defenses

Damaging Host Cells

Cytopathic Effects of Viruses

Pathogenic Properties of Fungi

Pathogenic Properties of Protozoa

Pathogenic Properties of Helminths

Pathogenic Properties of Algae

Portals of Exit

Mechanisms of Pathogenicity

- Pathogenicity: The ability to cause disease
- Virulence: The extent of pathogenicity

Portals of Entry

- Mucous membranes
- Skin
- Parenteral route
- Preferred portal of entry

Numbers of Invading Microbes

- ID50: Infectious dose for 50% of the test population
- LD50: Lethal dose (of a toxin) for 50% of the test population

Adherence

- Adhesins/ligands bind to receptors on host cells
 - Glycocalyx: *Streptococcus mutans*
 - Fimbriae: *Escherichia coli*
 - M protein: *Streptococcus pyogenes*
- Form biofilms

Capsules

- Prevent phagocytosis
 - *Streptococcus pneumoniae*
 - *Haemophilus influenzae*
 - *Bacillus anthracis*

Cell Wall Components

- M protein resists phagocytosis
 - *Streptococcus pyogenes*
- Opa protein inhibits T helper cells

- *Neisseria gonorrhoeae*
- Mycolic acid (waxy lipid) resists digestion
 - *Mycobacterium tuberculosis*

Enzymes

- Coagulase: Coagulates fibrinogen
- Kinases: Digest fibrin clots
- Hyaluronidase: Hydrolyzes hyaluronic acid
- Collagenase: Hydrolyzes collagen
- IgA proteases: Destroy IgA antibodies

Antigenic Variation

- Alter surface proteins

Penetration into the Host Cell Cytoskeleton

- Invasins
 - *Salmonella* alters host actin to enter a host cell
- Use actin to move from one cell to the next
 - *Listeria*

Membrane Ruffling

Using the Host's Nutrients: Siderophores

- Use host's iron

Direct Damage

- Disrupt host cell function
- Produce waste products
- Toxins

The Production of Toxins

- Toxin: Substance that contributes to pathogenicity
- Toxicity: Ability to produce a toxin
- Toxemia: Presence of toxin in the host's blood
- Toxoid: Inactivated toxin used in a vaccine
- Antitoxin: Antibodies against a specific toxin

Exotoxins

- Specific for a structure or function in host cell
- The Action of an A-B Exotoxin

Chapter 15
Microbial Mechanisms of Pathogenicity

Membrane-Disrupting Toxins

- Lyse host's cells by
- Making protein channels in the plasma membrane
 - Leukocidins
 - Hemolysins
 - Streptolysins
- Disrupting phospholipid bilayer

Superantigens

- Cause an intense immune response due to release of cytokines from host cells
- Symptoms: fever, nausea, vomiting, diarrhea, shock, and death

Exotoxins & Lysogenic Conversion

Endotoxins and the Pyrogenic Response

LAL Assay

- Limulus Amoebocyte Lysate assay
- Amoebocyte lysis produces a clot
- Endotoxin causes lysis

Inflammation Following Eye Surgery

- Patient did not have an infection
- The LAL assay of solution used in eye surgery
- What was the cause of the eye inflammation?
- What was the source?

Cytopathic Effects of Viruses

Pathogenic Properties of Fungi

- Fungal waste products may cause symptoms
- Chronic infections provoke an allergic response
- Tichotheocene toxins inhibit protein synthesis
 - *Fusarium*
- Proteases
 - *Candida*, *Trichophyton*
- Capsule prevents phagocytosis
 - *Cryptococcus*
- Ergot toxin
 - *Claviceps*

- Aflatoxin
 - *Aspergillus*
- Mycotoxins
 - Neurotoxins: Phalloidin, amanitin
 - *Amanita*

Pathogenic Properties of Protozoa

- Presence of protozoa
- Protozoan waste products may cause symptoms
- Avoid host defenses by
 - Growing in phagocytes
 - Antigenic variation

Pathogenic Properties of Helminths

- Use host tissue
- Presence of parasite interferes with host function
- Parasite's metabolic waste can cause symptoms

Pathogenic Properties of Algae

- Paralytic shellfish poisoning
 - Dinoflagellates
 - Saxitoxin

Portals of Exit

- Respiratory tract
 - Coughing and sneezing
- Gastrointestinal tract
 - Feces and saliva
- Genitourinary tract
 - Urine and vaginal secretions
- Skin
- Blood
 - Biting arthropods and needles or syringes