

1  **Chapter 15**

Microbial Mechanisms of Pathogenicity

2  **How Microbes Enter a Host**3  **Mechanisms of Pathogenicity**

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

4  **Portals of Entry**

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

5  **Numbers of Invading Microbes**

- ID<sub>50</sub>: Infectious dose for 50% of the test population
- LD<sub>50</sub>: Lethal dose (of a toxin) for 50% of the test population

6  ***Bacillus anthracis***7  **Toxins**8  **Adherence**

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

9  **Adherence**10  **Adherence**11  **Adherence**12 

- ✓ List three portals of entry, and describe how microorganisms gain access through each. 15-1
- ✓ The LD<sub>50</sub> of botulinum toxin is 0.03 ng/kg; the LD<sub>50</sub> of Salmonella toxin is 12 mg/kg. Which is the more potent toxin? 15-2
- ✓ How would a drug that binds mannose on human cells affect a pathogenic bacterium? 15-3
- ✓

13  **How Pathogens Penetrate Host Defenses**14  **Capsules**

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

15  **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*

16  **Enzymes**

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

17  **Antigenic Variation**

- Alter surface proteins

18  **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*

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- ✓ What function do capsules and M proteins have in common? 15-4
- ✓ Would you expect a bacterium to make coagulase and kinase simultaneously? 15-5
- ✓ Many vaccines provide years of protection against a disease. Why doesn't the influenza vaccine offer more than a few months of protection? 15-6
- ✓ How does *E. coli* cause membrane ruffling? 15-7

20  **How Pathogens Damage Host Cells**21  **Using the Host's Nutrients: Siderophores**

- Use host's iron

22  **Direct Damage**

- Disrupt host cell function
- Produce waste products
- Toxins

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- ✓ Of what value are siderophores? 15-8
- ✓ How does toxigenicity differ from direct damage? 15-9

24  **The Production of Toxins**

- Toxin: Substance that contributes to pathogenicity
- Toxigenicity: 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

25  **Exotoxins and Endotoxins**26  **Exotoxins**

- Specific for a structure or function in host cell

27  **The Action of an A-B Exotoxin**28  **Membrane-Disrupting Toxins**

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

29  **Superantigens**

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

30  **Exotoxin**31  **Exotoxins & Lysogenic Conversion**32  **Endotoxins**33  **Endotoxins and the Pyrogenic Response**34 

- ✓ Differentiate an exotoxin from an endotoxin. 15-10
- ✓ Food poisoning can be divided into two categories: food infection and food intoxication. On the basis of toxin production by bacteria, explain the difference between these two categories. 15-11

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- ✓ Washwater containing *Pseudomonas* was sterilized and used to wash cardiac catheters. Three patients developed fever, chills, and hypotension following cardiac catheterization. The water and catheters were sterile. Why did the patients show these reactions? How should the water have been tested? 15-12
- ✓ How can lysogeny turn the normally harmless *E. coli* into a pathogen? 15-13

36  **Pathogenic Properties**37  **Pathogenic Properties of Fungi**

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

38  **Pathogenic Properties of Fungi**

- Ergot toxin ( cause hallucination and death)
  - *Claviceps*
- Aflatoxin (toxic and among the most carcinogenic substances known )
  - *Aspergillus*
- Mycotoxins (neurotoxins)
  - Neurotoxins: Phalloidin, amanitin
    - Amanita*

39  **Pathogenic Properties of Protozoa**

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

40  **Pathogenic Properties of Helminths**

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

41  **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

42  **Mechanisms of Pathogenicity**43 

- ✓ Define *cytopathic effects*, and give five examples. 15-14
- ✓ Identify one virulence factor that contributes to the pathogenicity of each of the following diseases: fungal, protozoan, helminthic, and algal. 15-15
- ✓ Which are the most often used portals of exit? 15-16