Microbe-Human Interactions: Infection and Disease

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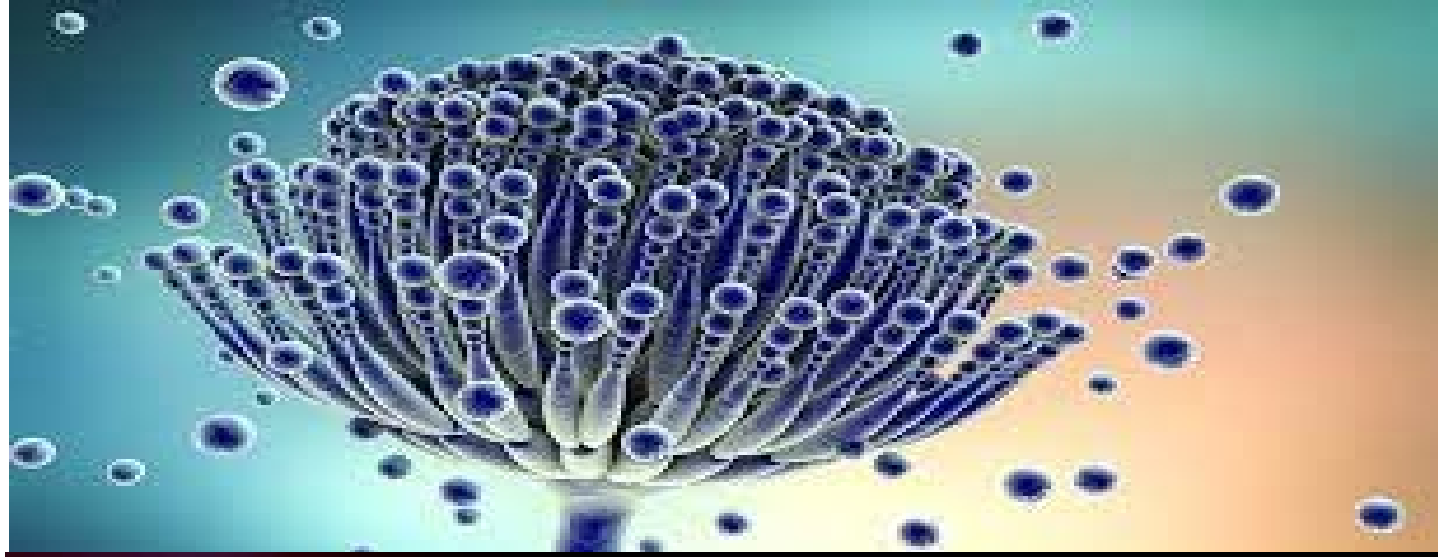
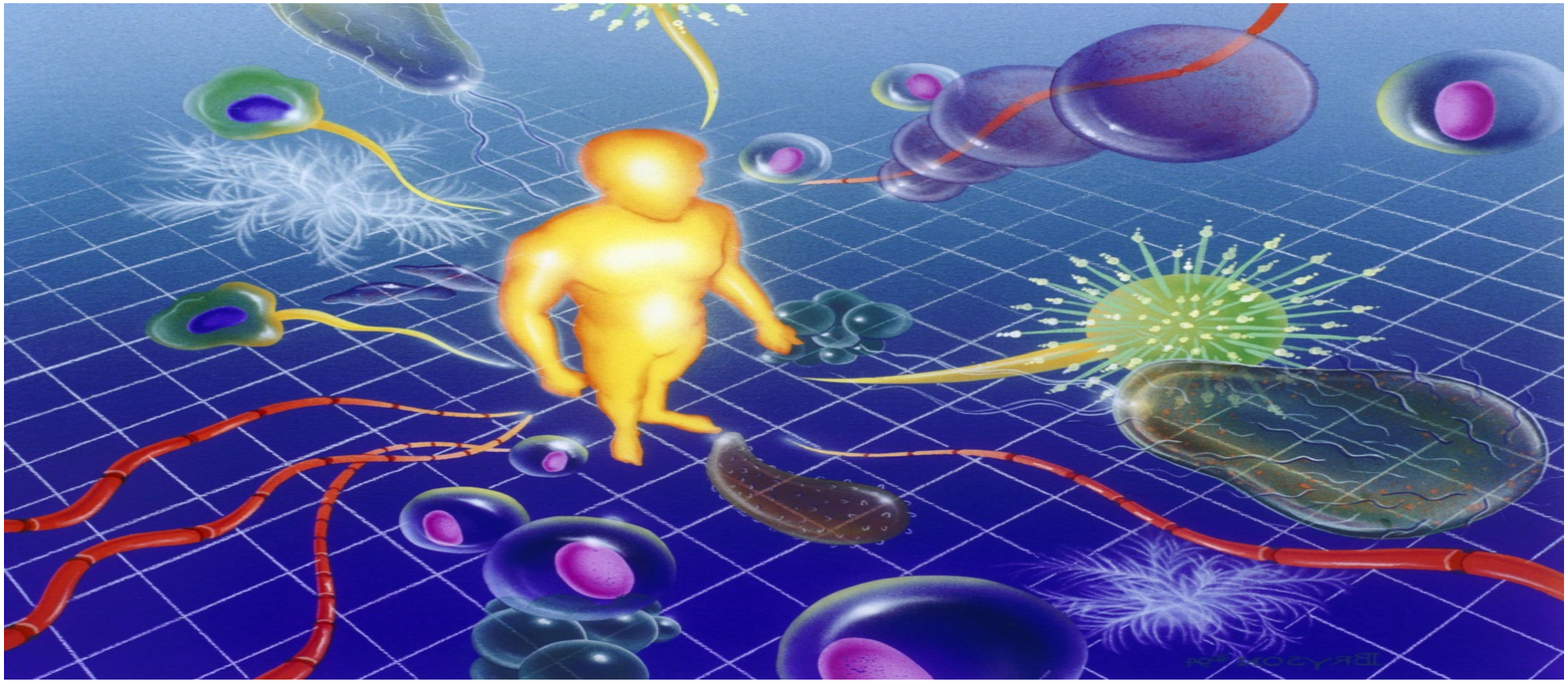


- ***Medical microbiology*** **is the study of causative agents of infectious diseases of humans and their reactions to such infections. In other words it deals with etiology, pathogenesis, laboratory diagnosis, specific treatment and control of infection (immunization).**



Contact, Colonization, Infection, Disease

- Microbes that engage in mutual or commensal associations – **normal (resident) flora**, indigenous flora, microbiota

- **Infection** – a condition in which pathogenic microbes penetrate host defenses, enter tissues, and multiply
- **Pathogen** – infectious agent
- **Infectious disease** – an infection that causes damage or disruption to tissues and organs

Major Factors in the Development of an Infection

- **True pathogens** – capable of causing disease in healthy persons with normal immune defenses
  - Influenza virus, plague bacillus, malarial protozoan

- **Opportunistic pathogens** – cause disease when the host's defenses are compromised or when they grow in part of the body that is not natural to them
  - *Pseudomonas s*p & *Candida albicans*

- Severity of the disease depends on the **virulence** of the pathogen; characteristic or structure that contributes to the ability of a microbe to cause disease is a **virulence factor.**

Major Factors in the Development of an Infection

TABLE 13.4 Factors That Weaken Host Defenses and Increase Susceptibility to Infection*

- Old age and extreme youth (infancy, prematurity)
- Genetic defects in immunity and acquired defects in immunity
- Surgery and organ transplants
- Organic disease: cancer, liver malfunction, diabetes
- Chemotherapy/immunosuppressive drugs
- Physical and mental stress
- Other infections

Becoming Established

Portals of entry –characteristic route a microbe follows to enter the tissues of the body

–Skin –nicks, abrasions, punctures, incisions

–Gastrointestinal tract –food, drink, and other ingested materials

–Respiratory tract –oral and nasal cavities

–Urogenital tract –sexual, displaced organisms

–Transplacental

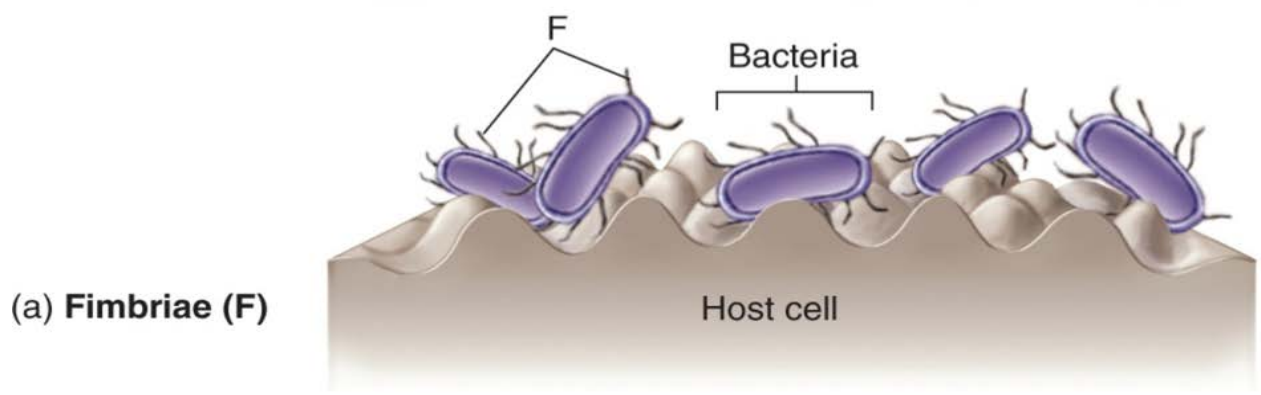
- **Exogenous agents** originate from source outside the body
- **Endogenous agents** already exist on or in the body (normal flora)

Requirement for an Infectious Dose (ID)

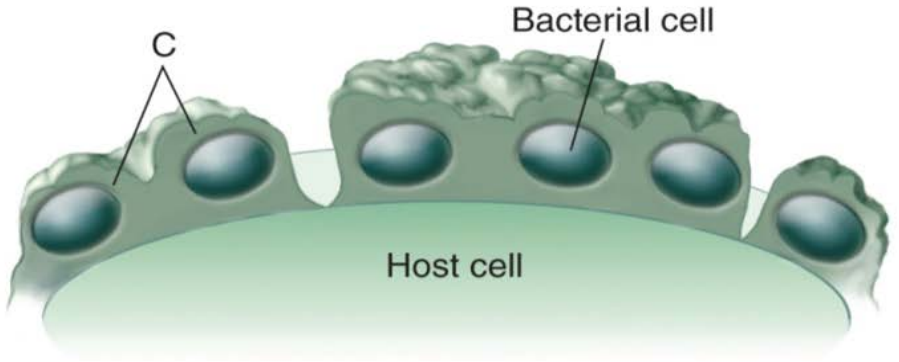
- Dose refers to the number of parasites that must be taken into the body in order for disease to be established
- Minimum number of microbes required for infection to proceed
- Microbes with small IDs have greater virulence
- Lack of ID will not result in infection

Attaching to the Host

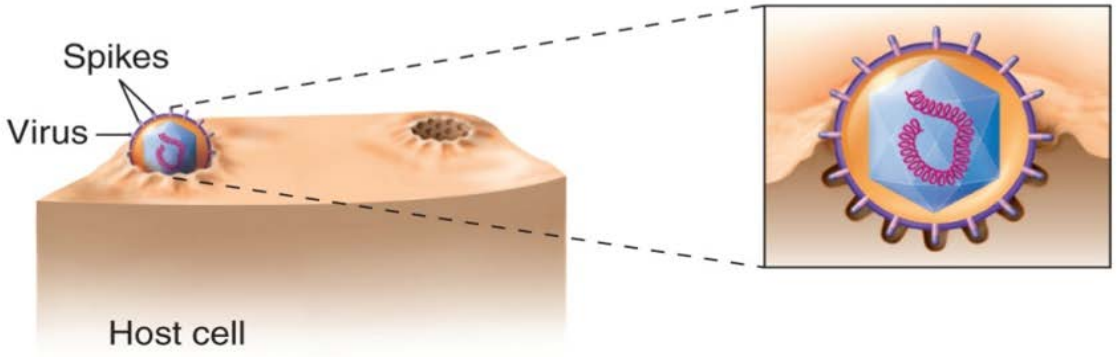
- **Adhesion** – microbes gain a stable foothold at the portal of entry; dependent on binding between specific molecules on host and pathogen
  - Fimbriae
  - Flagella
  - Glycocalyx
  - Cilia
  - Suckers
  - Hooks
  - Barbs



(a) **Fimbriae (F)**



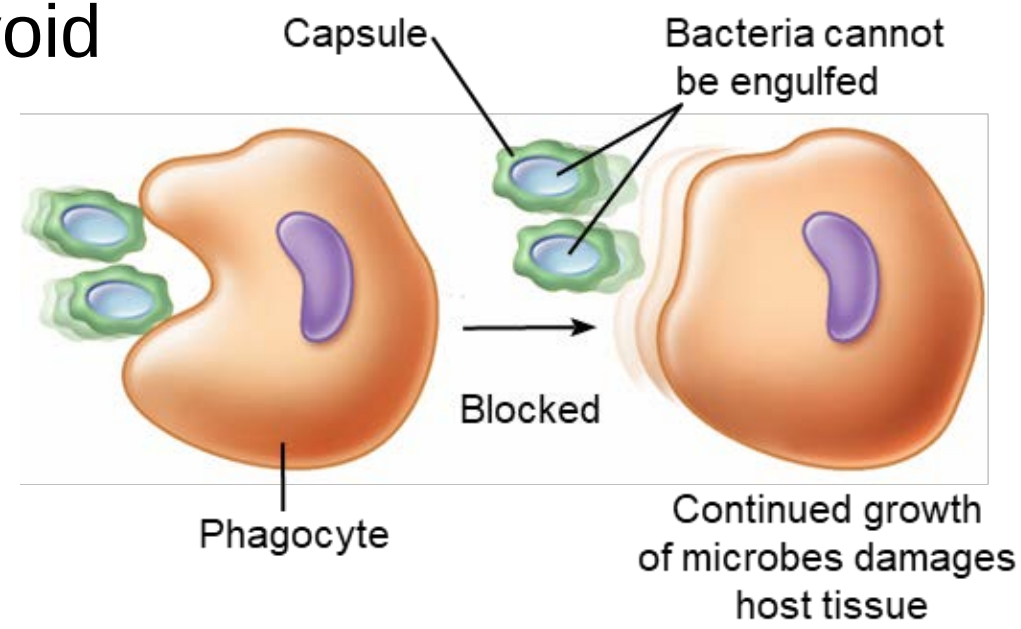
(b) **Capsules (C)**



(c) **Spikes (S)**

Surviving Host Defenses

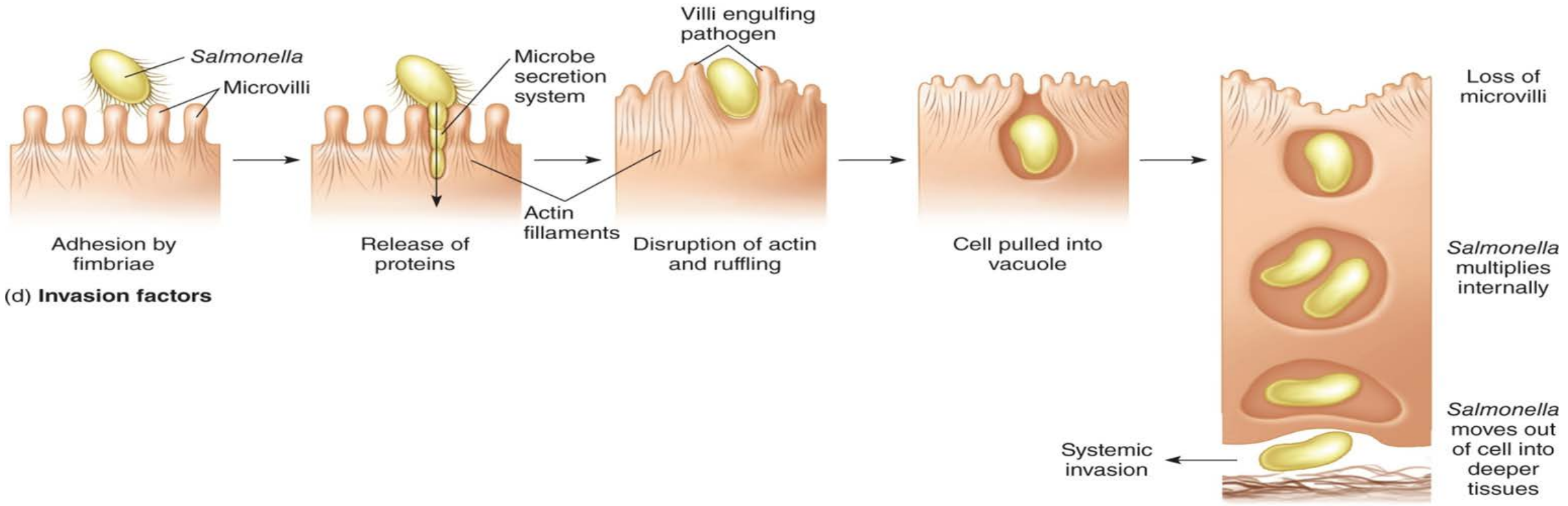
- Initial response of host defenses comes from **phagocytes**
- **Antiphagocytic factors** – used to avoid phagocytosis
- Species of *Staphylococcus* and *Streptococcus* produce **leukocidins**, toxic to white blood cells
- **Slime layer** or **capsule** – makes phagocytosis difficult
- Ability to survive intracellular phagocytosis



(c) **Blocked phagocytic response**

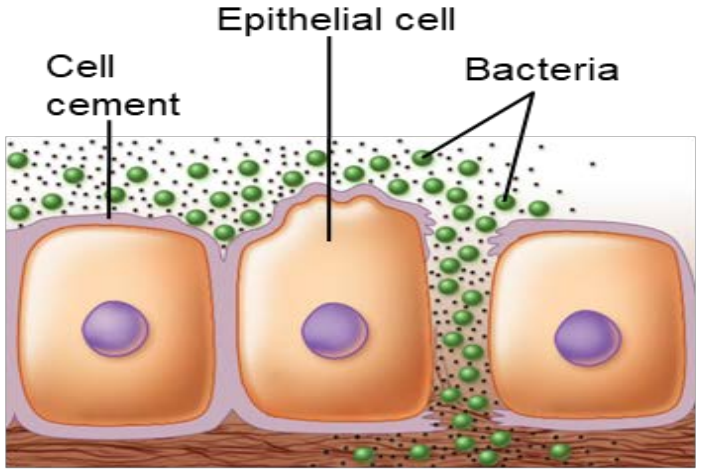
Entering Host Tissues

- Some pathogens produce a secretion system to insert specialized virulence proteins directly into the host cells

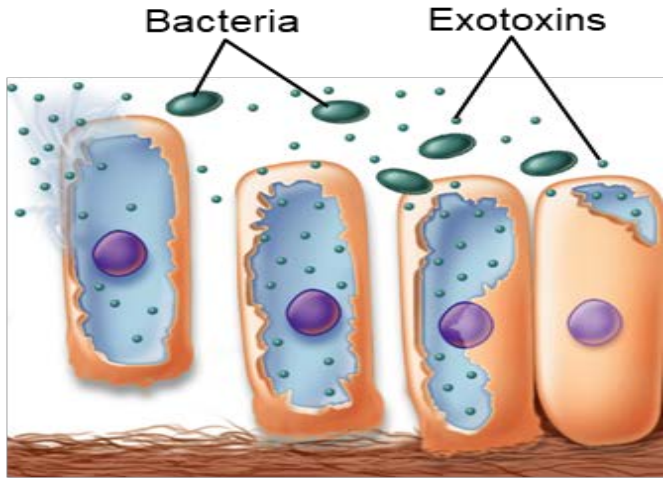


Causing Disease

- **Virulence factors** – traits used to invade and establish themselves in the host, also determine the degree of tissue damage that occurs – severity of disease
- **Exoenzymes** – dissolve extracellular barriers and penetrate through or between cells
- **Toxigenicity** – capacity to produce toxins at the site of multiplication



(a) **Exoenzymes**



(b) **Toxins**

Exoenzymes

- Exoenzymes are enzymes released by the pathogen into their surrounding environment. These enzymes break down tissues and allow the bacteria to infiltrate deeper into the body. Examples: hyaluronidase digests hyaluronic acid, a compound that glues cells together and collagenase, which digests collagen, an important protein in connective tissue.

Bacterial Toxins: A Potent Source of Cellular Damage

- 2 Types of Bacterial Toxins:
  - **Endotoxin** – toxin that is not secreted but is released after the cell is damaged
    - Composed of lipopolysaccharide (LPS), part of the outer membrane of gram-negative cell walls
  - **Exotoxin** – toxin molecule secreted by a living bacterial cell into the infected tissue
    - Strong specificity for a target cell
    - Hemolysins
    - A-B toxins (A-active, B-binding)

The Process of Infection and Disease

- four distinct stages of clinical infections:
  - **Incubation period** – time from initial contact with the infectious agent to the appearance of first symptoms; agent is multiplying but damage is insufficient to cause symptoms; several hours to several years
  - **Prodromal stage** – vague feelings of discomfort; nonspecific complaints
  - **Period of invasion** – multiplies at high levels, becomes well-established; more specific signs and symptoms
  - **Convalescent period** – as person begins to respond to the infection, symptoms decline

Patterns of Infection

- **Localized infection** – microbes enter the body and remains confined to a specific tissue
- **Systemic infection** – infection spreads to several sites and tissue fluids usually in the bloodstream
- **Focal infection** – when infectious agent breaks loose from a local infection and is carried to other tissues

Patterns of Infection

- **Mixed infection** – several microbes grow simultaneously at the infection site - **polymicrobial**
- **Primary infection** – initial infection
- **Secondary infection** – another infection by a different microbe
- **Acute infection** – comes on rapidly, with severe but short-lived effects
- **Chronic infections** – progress and persist over a long period of time

نهاية المحاضرة