



Basrah University
Al-Qurna Education college
Biology department: 4th Stage



**2nd Course : Bacterial Infection &
pathogenesis**

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Objectives

- * To define the general terms used in pathogenesis
- * To explain the virulence factors and examples
- * To explain the infection and its types
- * To understand the mechanism of pathogenesis
- * To clarify the immunopathogenesis



*General Terms Used In Pathogenesis:

Commensals: harmless microbes living on the host and causing no ill or effect / injury to the host.

pathogen is a microorganism that is able to cause disease in a human, animal, plant or insect.

Pathogenicity is the ability of bacteria to cause a disease in a host .

Virulence: is the degree of pathogenicity. It depends on invasiveness and toxigenicity of the organism.

Infection : Growth and multiplication of a microbe in or on the body with or without the production of disease.

Acute Infection:an infection characterized by sudden onset, rapid progression, and often with severe symptoms

Chronic Infection:an infection characterized by delayed onset and slow progression

Colonization: Pathogen enters, multiplies, does not invade



Opportunistic Pathogen: Cause disease in immunocompromised people

- (HIV, Solid organ transplant patient, Chemotherapy) .

Opportunistic infection

An infection caused by microorganisms that are commonly found in the host's environment.

Incubation Period: The time interval between the entry of the infectious agent and the onset of clinical manifestations of the disease

This period may be as short as minutes to as long as years .

The suffix “**-emia**” A suffix meaning “presence of an infectious agent” in bloodstream

Bacteremia = Presence of the bacteria in bloodstream

Viremia = Presence of the virus in bloodstream

Fungemia = Presence of the fungus in bloodstream

Septicemia = Presence of an infectious agent with its toxins in the bloodstream

Toxemia : Presence of the microbial toxins in bloodstream



Infection:

*Infection: The growth of a parasitic organism (a "germ") within the body. e.g. Bacteria

*Types Of Infections:

1. Communicable Infection:

An infection that can be transmitted from one individual to another either directly by contact or indirectly by fomites and vectors.

2. Asymptomatic Infection:

a disease is considered asymptomatic if a patient is a carrier for a disease or infection but experiences no symptoms.

* A condition might be asymptomatic if it fails to show the noticeable symptoms.

*also called subclinical infections.



3. Symptomatic Infection:

a disease is considered symptomatic if a patient is a carrier for a disease or infection and express symptoms . e.g. fever.

- **Pandemic infection:**

pandemic is an epidemic of infectious disease that is spreading through human populations across a large region; for instance multiple continents, or even worldwide.

- **Epidemic infection:**

A disease condition present in a greater than usual percentage of a specific population

- **Endemic infection:**

Endemic infection Prevalent in or restricted to a particular region, community, or group of people.



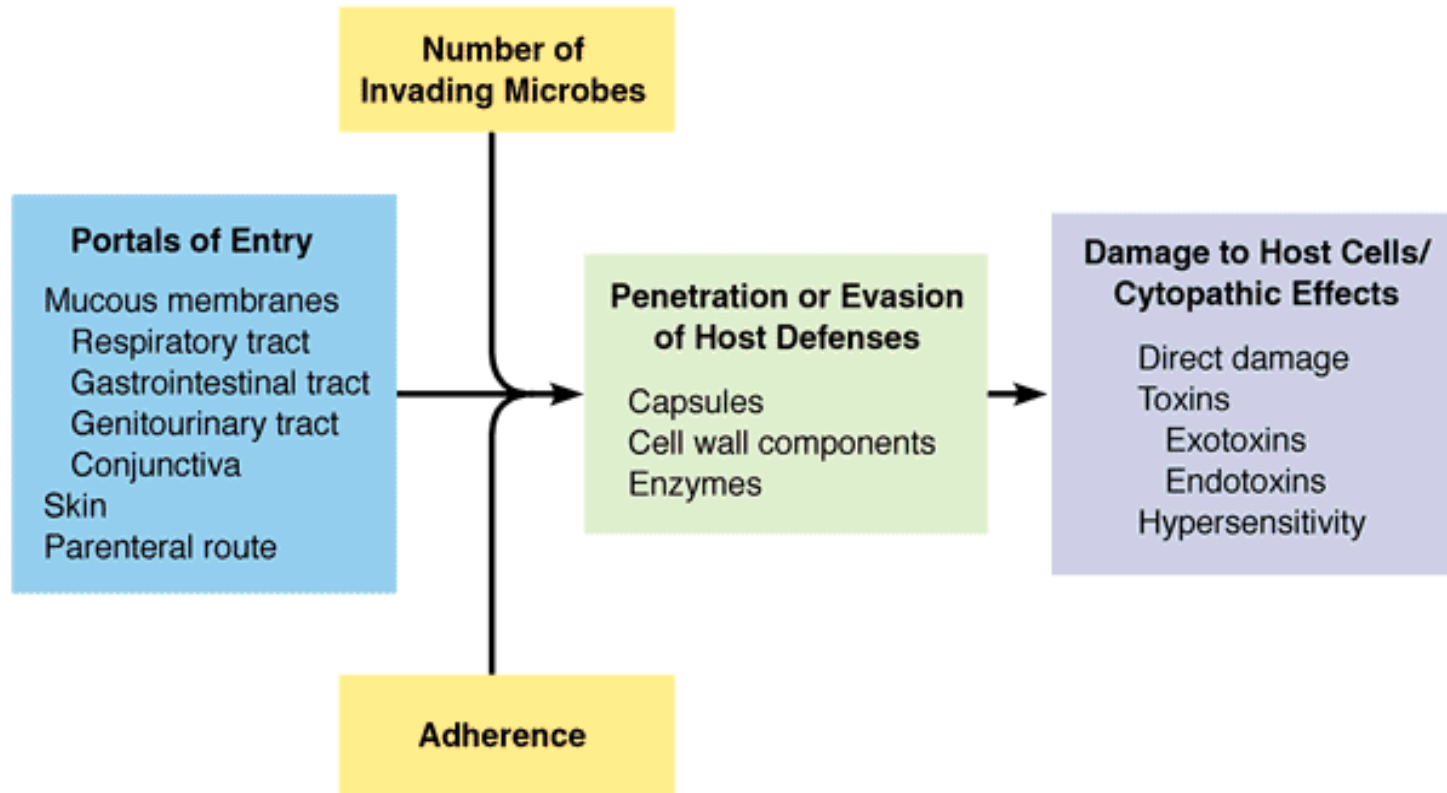
Characteristics of Pathogenic Bacteria

1. Transmissibility
2. Adherence to host cells
3. Invasion of host cells and tissue
4. Evasion of the host immune system
5. Toxigenicity : ability to produce toxins.

Bacteria may produce two types of toxins:

- i. Exotoxins
- ii. Endotoxins.

Microbial Mechanisms of Pathogenicity





Mode of transmission:

Entry into human body

1. Ingestion : (food or water)

Salmonella typhi

Shigella dysenteriae

Vibrio cholerae

2. Inhalation: (Respiratory Tract)

Mycobacterium tuberculosis:

Streptococcus pneumonia

Haemophilus influenzae

3. Direct contact

Unclean hands: Common cold, skin and eye infections

Break in the skin (wounds): *Staphylococcus aureus*

Burns: *Pseudomonas aeruginosa*

Trauma : *Clostridium tetani*



Entry into human body

4. Sexual transmission :

Neisseria gonorrhoeae (gonorrhea)

Treponema pallidum (syphilis)

Chlamydia trachomatis

5. Blood borne transmission

Needle stick injuries / Blood transfusion / Intravenous drug abuse:

HIV, HBV, HCV

6. Vector borne:

Mechanical: Flies spreading bacteria to food (*Salmonella/ shigella*)

Biological: *Y. pestis* multiplying in flea gut

7. Vertical transmission Mechanical vectors-

Treponema pallidum (syphilis)

Toxoplasma

Cytomegalovirus



Virulence factors:

Factors enhancing the ability of bacteria to cause disease. or molecules expressed and secreted by pathogens (bacteria, viruses, fungi and protozoa) that enable them to achieve the following:

Colonization, Immuno-evasion, Immunosuppression, entry into and exit out of cells (if the pathogen is an intracellular one) and to obtain nutrition from the host.

*Pathogens possess a wide array of virulence factors. Some are intrinsic to the bacteria (e.g. capsules and endotoxin) whereas others are obtained from plasmids (e.g. some toxins).



Colonization factors; Adherence

Adhesins

The pathogenesis of many bacteria depend on the ability to adhere to mucosal cells (epithelial or endothelial cell linings of bladder, intestine and blood vessels) as a first step

1. Pili (fimbriae) : binds to glycolipids or glycoproteins
2. Adhesins : M protein in *Streptococcus pyogenes*, lipoteichoic acids in Gram positive bacteria
3. Biofilms : (Adhere strongly to catheters, heart valves, knee joint replacement prosthesis)



Invasiveness:

The ability to invade tissues. encompasses mechanisms for

- Colonization (adherence and initial multiplication),
- production of extracellular substances which facilitate invasion (invasins)and
- Ability to bypass or overcome host defense mechanisms

Exoenzymes

- Many bacteria release enzymes that can damage host tissue in a variety of mechanisms , such as collagenase, hyaluronidase , fibrinolysins , proteases, lecithinases



Exotoxins

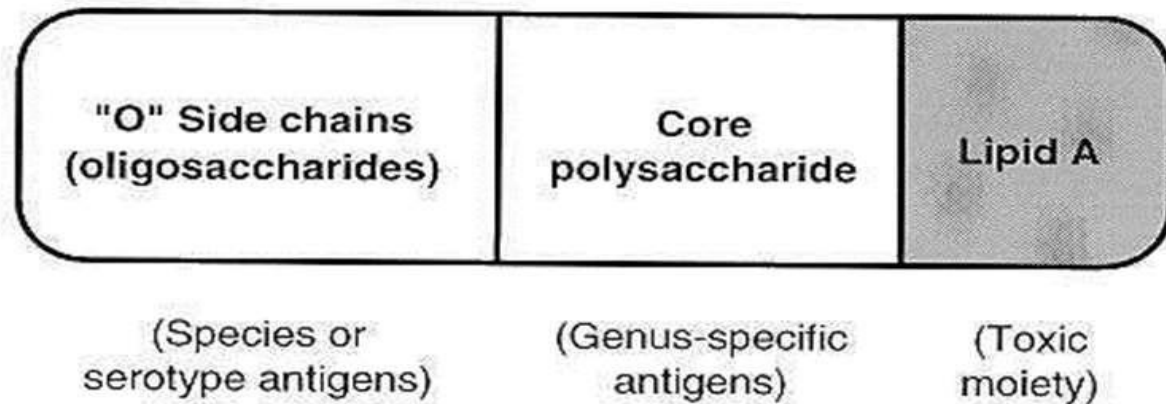
- *Polypeptide in nature.
- *Secreted by both gram positive and gram negative species outside of the cell
- *Induce high titer antibodies called antitoxins.
- *Most toxic substance known.
- *Toxoid used as vaccine.
- *Can be divided into three categories:
 - *Cytotoxins , *Neurotoxins , *Enterotoxins
 - e.g *Corynebacterium diphtheriae* toxin
 - Clostridium tetanii*
 - Vibrio cholerae* toxin
 - Staphylococcus aureus* Enterotoxin
 - Shigella dysenteriae* toxin



Endotoxin

- The lipo-polysachharide (**LPS**) component of Gram negative bacterial outer membrane is called the Endotoxin
- Lipid A component of lipo-polysachharide (LPS)
- Stimulates release of acute phase cytokines (IL-1, TNF- α and IL-6) and inflammatory reactions
- Leading to high fever, hypotension and shock

Basic structure of endotoxin





EXOTOXIN

1. Released from the cell before or after lysis
2. Protein
3. Heat labile
4. Antigenic and immunogenic
5. Toxoids can be produced
6. Specific in effect on host
7. Produced by gram-positive and gram-negative org.
8. No fever



ENDOTOXIN

1. Integral part of cell wall
2. Endotoxin is LPS; Lipid A is toxic component
3. Heat stable
4. Antigenic; ??immunogenicity
5. Toxoids cannot be produced
6. Many effects on host
7. Produced by gram-negative organisms only
8. Fever present



Microbial defenses against host immunologic clearance

- Encapsulation (Inhibition of phagocytosis and serum bactericidal effect) e.g. *Neisseria meningitidis*, *Streptococcus pneumoniae*
- Antigenic or phase variation (*Salmonella typhi*)
- Intracellular multiplication (*M. tuberculosis*, *Salmonella typhi*)
- Production of anti-immunoglobulin protease (IgA protease)
- Inhibition of chemotaxis (C5a peptidase)
- Destruction of phagocytes



