Medical Microbiology

Lec. 4

pathogenesis of bacterial infection

By:

Lecturer Shaima'a Al-Salihy

Pathogenesis: is the mechanisms of origination and development of signs and symptoms of disease.

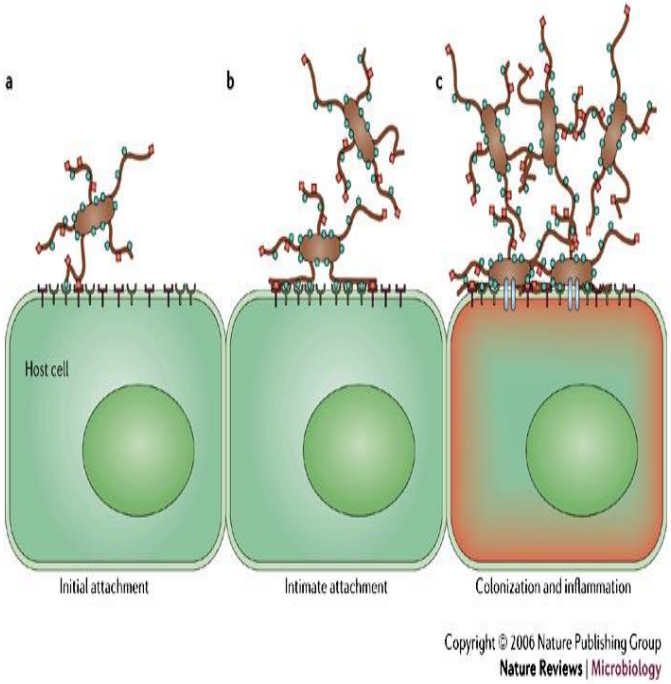
Pathogenicity: The ability of an infectious agent to cause disease.

Pathogen: A microorganism capable of causing disease especially in immunocompetent people.

Types of pathogen:

- Obligate pathogen
- Typical pathogen
- Opportunistic pathogen

Pathogenesis of bacterial infection



Infection: Multiplication of an infectious agent (pathogenic bacteria but not normal flora) within the body even if the person is asymptomatic.

Infectious agents cause disease by either **toxin production** or **invasion and inflammation**.

Infectious dose (ID_{50}): is the number of organisms needed to cause infection in half the host.

Types of infection:

1. **Primary infection:** initial infection with an organism in a host.
2. **Reinfection:** subsequent infection with the same organism in the same host.

3. **Secondary infection:** infection with new organism in a host whose body resistance is already lowered by a pre-existing infectious disease.
4. **cross infection:** infection with a new organism from another host or another external source in a patient who is already suffering from a disease.
5. **Nosocomial infection:** cross-infection acquired in hospital.
6. **Subclinical infection:** inapparent **clinical infection** (which has a number of outcomes covering the spectrum between death and complete recovery).
7. **Latent infection:** hidden stage of microorganism in a host and subsequent multiplication to produce clinical disease when host resistance is lowered.
8. **Chronic infection:** situation where a person continues to harbor a pathogenic organism but suffer no ill-effects themselves

Stages of bacterial pathogenesis:

1. **Transmission** from an external source into the portal of entry.
2. **Evasion** of primary host defenses such as skin or stomach acid.
3. **Adherence** to mucous membranes, usually by bacterial pili.
4. **Colonization** by growth of the bacteria at the site of adherence.
5. **Disease symptoms** caused by toxin or inflammation.
6. **Host response** during 3,4 and 5.
7. **Progression** or resolution of the disease.

Q//How to determine the real cause of the disease ?

The answer depend on:

1- Awareness of two phenomena:

- **Normal flora:** it refers to various bacteria and fungi that are permanent residents of certain body sites, especially the skin, oropharynx, colon, and vagina.
- **Colonization:** it refers to the presence of a new organism that is neither member of normal flora nor the cause of symptoms.

2-Koch's postulates

Typical Stages of an infectious disease

A typical acute infectious disease has four stages:

1. **Incubation period:** is the time between the acquisition of the organism(or toxin) and the first appearance of clinical symptoms.
2. **Prodrome period:** during which non specific symptoms such as (fever, malaise, and loss of appetite) are noted.
3. **Specific illness period:** during which the overt signs and symptoms of the disease occur.
4. **Recovery period:** during which regression of disease occur and the patient returns to the healthy state.
5. **convalescence** where the symptoms have largely disappeared.

Bacterial virulence factors

The time course and severity of the disease depends upon the balance between the **virulence** of the infecting agent and the success of the **immune system** to combat the organism.

Virulence: The quantitative measure of microorganism's ability to cause disease.

The ability of bacteria to cause disease is described in terms of the number of infecting bacteria, the route of entry into the body, the effects of host defense mechanisms, and intrinsic characteristics of the bacteria called **virulence factor**.

Bacterial virulence factors

Virulence factors: are molecules coded for by genes in chromosomal DNA or plasmid, expressed and secreted by pathogens (bacteria, viruses, fungi and protozoa) that enable them to achieve the following:

1. colonization of the host (this includes adhesion to cells)
2. Immuno-evasion, evasion of the host's immune response
3. Immunosuppression, inhibition of the host's immune response
4. entry into and exit out of cells (if the pathogen is an intracellular one)
5. obtain nutrition from the host.

Bacterial virulence factors

- Pathogens possess a wide array of virulence factors. Some are intrinsic to the bacteria (e.g. capsules and endotoxin whereas others are obtained from plasmid (e.g. some toxins).
- **Toxins:** are divided into two groups: **endotoxin** and **exotoxin.**
- **Endotoxin**: lipopolysaccharide (LPS) is a prototypical example of an endotoxin, which is a component of the cell wall of Gram-negative bacteria.
- **Exotoxins** are actively secreted by some bacteria and have a wide range of affects including inhibition of certain biochemical pathways in the host. The two most potent exotoxins known to man are the tetanus toxin (**tetanospasmin**) and (**botulin**).
- **Pili, capsule, glycocalyx:** allow the bacteria to adhere to surfasce of human cell. Capsules play important roles in immune evasion, as they inhibit phagocytosis, as well as protecting the bacteria while outside a host
- **Immunoglobuline (Ig) proteases:** break down host's Ig.

Bacterial virulence factors

- **Enzymes include:**

- **hyaluronidase:** which breaks down the connective tissue component hyaluronic acid
- **proteases and lipases**
- **DNAses:** which break down DNA
- ***Hemolysins:*** which break down a variety of host cells, including red blood cells.

- Immunopathogenesis: Host-mediated pathogenesis is often important because the host can respond aggressively to infection with the result that host defense mechanisms cause damage to host tissues.