**College of Medicine Dr. Bara Hamid Hadi**

**Microbiology (Bacteriology) Dr. Zainab Adil Chabuck**

**Lecture-3**

…………………………………………………………………………………………

**Microbial Pathogenesis and infection**

**Pathogenesis:** The process of pathogenesis involves various steps and stages beginning with the transmission of the infectious agent (bacterial) to the host, till the progression or resolution of the disease. So the important stages of bacterial pathogenesis are:

* Transmission from an external source into the portal of entry.
* Evasion of primary host defenses.
* Adherence to mucous membranes.
* Colonization by growth of the bacteria at the site of adherence.
* Disease symptoms.
* Host responses.
* progression or resolution of the disease.

**Infection** is the presence and multiplication of pathogenic microbe within human body, and cause symptoms of infection. The infection differs from other diseases is that caused by living microbial pathogens.

Infection is determined by balance between number and virulence of microbe (degree of pathogenicity) and competency of that host defense (resistance). If microbes are overcome, the disease results.

**Pathogen:** micro-organism has ability to cause disease, some are highly pathogenic and some are not; depending on their virulence factors.

**Opportunistic pathogen**: organisms that take advantage of an opportunity of reduced immunity and cause infection in immunocompromised individuals, it is frequently a member of the body’s normal flora.

**ID50:** infectious dose required to cause disease in 50% of inoculated test animals.

**Sources of infection:**

Common source of infections is human whether patients or carriers, animals whether reservoir or vector, food, water and soil.

**Portals of entry (routes of infection) :**

**Major**: **Minor** :

1. Respiratory tract (nose). 1. Eye.

2. Elementary tract (mouth). 2. Anus

3. Skin, non-intact. 3. Ear canal

4.Genital tract (vagina). 4. Urethral canal.

**Mode of transmission**

**A-Horizontal transmission:** it is person-to-person transmission of infection , this occur via inhalation, ingestion, skin, blood transfusion and sexual contact.

**B- Vertical transmission:**

The pathogen can transmitted from infected mother to her fetus:

-Across the placenta (prenatal).

-At time of delivery from birth canal (perinatal).

-During breast feeding (postnatal).

**Determinants of bacterial pathogenesis:**

**Adhesion**: is essential for colonization and then penetration through tissues, to acquire essential nutrients for growth. It involves surface interactions between specific receptors on the mammalian cell membrane and ligands on the bacterial surface.

Many bacteria express pili which are involved in mediating attachment to mammalian cell surfaces; flagella, cell wall, capsule, teichoic acid and other surface determinants that aid in the bacterial adhesion.

It is necessary for virulence, blocking adhesion can prevent disease.

**Invasion:** is ability of microorganism to spread into host tissues. Some bacteria are non-invasive, but multiply at site of adherence.

Bacteria secret several invasive factors (spreading factors) that result in degrading tissue and facilitate the pathogen spreading through human body, eg. Collagenase, elastase, haemolysin, streptokinase, hyaluronidase and coagulase.

**Evasion of host defense:** play important role in resistance of pathogenic organism to host defenses:

 Certain bacteria have capsule, teichoic acid that prevent phagocytosis.

 Certain pathogens able to survive and grow intracellularly as it has ability to inhibit the fusion of phagosome with lysosome within phagocytic cells.

 Certain bacteria secrete enzymes (eg.IgA protease) that destroy antibody IgA.

 Certain bacteria produce toxin (such as leucocidin) that lead to destroy the immunity cells.

 Change in genetic materials lead to antigenic variation.

**Mechanism of cell damage and death:**

Pathogenic microbes cause damage of tissue by two main mechanisms of pathogenesis:

**1.** Production of toxins and enzymes.

**2.** Immunopathological reactions.

**Toxin production (toxigenicity):** ability of pathogen to produces toxin that damage the host tissue and produce disease. Bacterial pathogens produce two types of toxins; exotoxin and endotoxin.

|  |  |  |
| --- | --- | --- |
| **Characteristics** | **Exotoxins** | **Endotoxins** |
| **Source** | Living gram positive and gram negative bacteria | Lysed gram negative bacteria only |
| **Location** | Secreted from cell | Part of cell (OM) |
| **Chemical Composition** | Protein | Lipopolysaccaride |
| **Heat Sensitivity** | Liable (60-80C) | Stable (250C) |
| **Immune Reactions** | Strong | Weak |
| **Conversion to Toxoids** | Possible (vaccine) | Not possible |
| **Fever** | No | Yes |
| **Specificity** | Specific to particular bacterial strain | Non specific |
| **Toxicity** | High | Poor |
| **Examples** | Tetanus, Botulism, Diphtheria | (G-ve rods) *E.coli*, Salmonella typhi, Shigella. |

**Immunopathological reaction:**

-Microbial pathogens may stimulate the immune system to attack the host tissue because it carries antigens that resembled those of host. It may be appears as autoimmune response(the immune system fails to distinguish between self and non-self, and attacks part of the body) or as cross-reaction between antigens of pathogenic microbes and antigenic components of human body.

-Some diseases also might be due to hypersensitivity reaction (the immune response that damages the body's own tissues). Tuberculosis is a good example of involvement of hypersensitivity reaction in disease.

**Mechanical effects of microbes:**

1-Mechanical obstruction results from pathogen.

2-Mechanical obstruction results not from microbe but from response of inflammatory host.

**Persistence of infection:**

It mean the microbes may continue to multiply and able to infect other hosts. Persistent infections represent a failure of host defenses to eliminate the microbe from the body.

Three types of persistent microbial infections:

**1. Chronic infections:** patients who have infected with some microbes and continue to produce significant symptoms of disease and significant amount of microbes for long period.

**2. Latent infection:** some patients recover from initial infection and microbe production stops. However, the patients harboring the microbe in their bodies (carriers).

**3. Slow microbial infections:** some infections require long period between initial infection and onset of disease, which are usually measured in years (such as HIV, TB).